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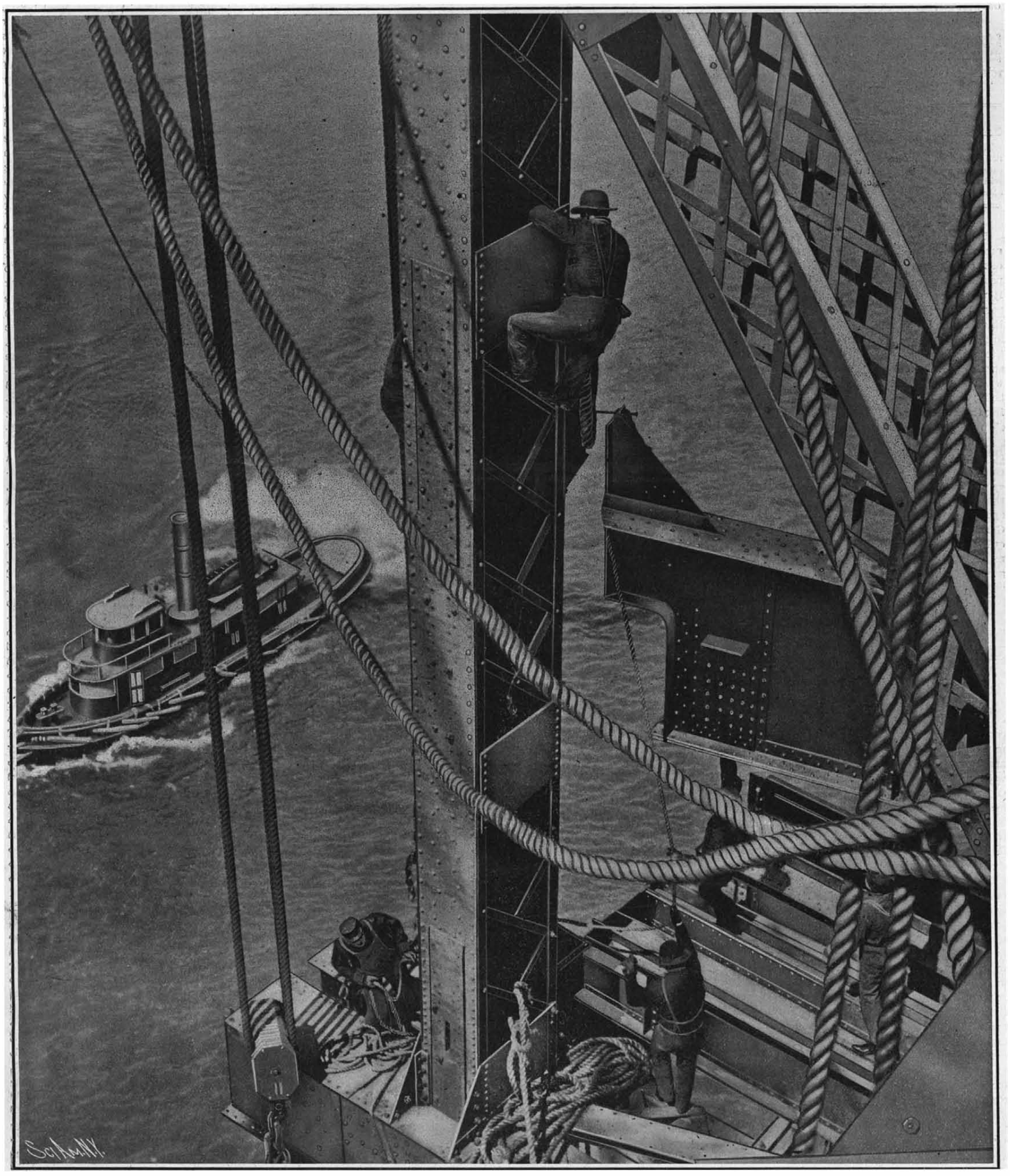
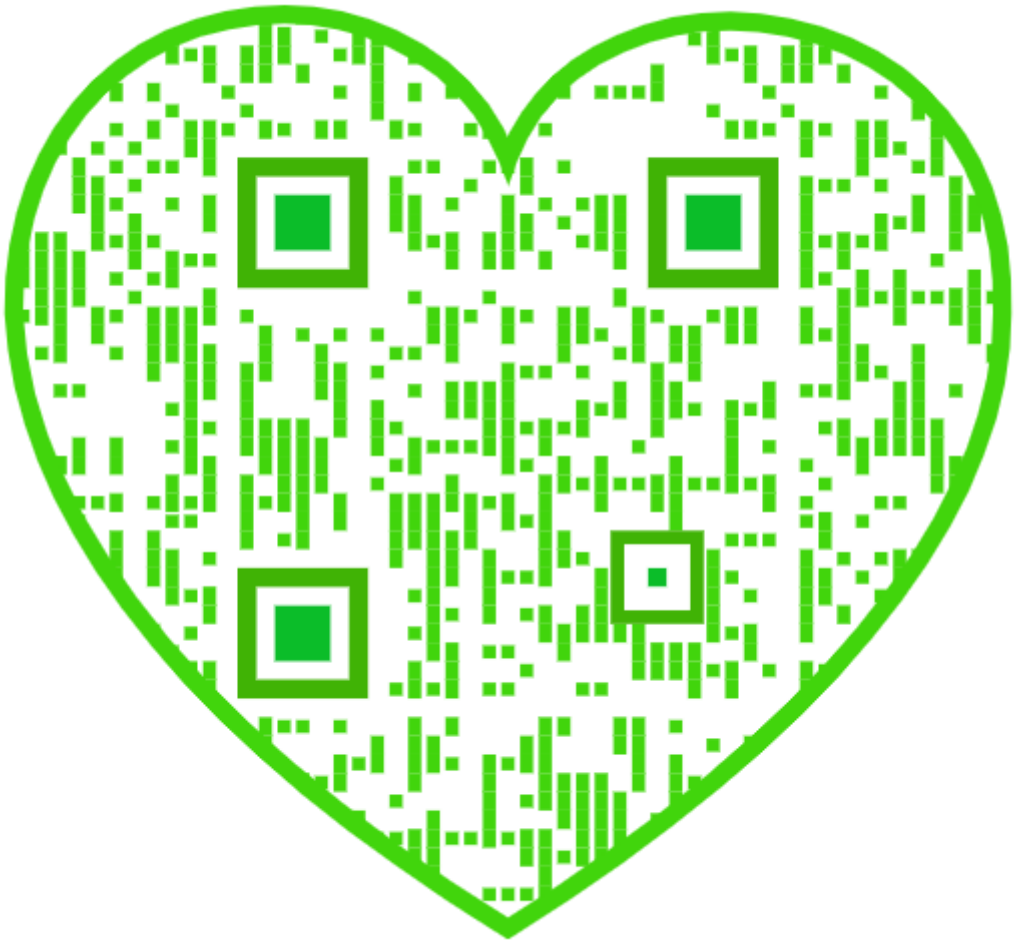


At Work Erecting the Cantilever. The View is Taken 160 Feet in Mid-Air and 500 Feet Out from the Point of Support.

ERECTING THE GREAT CANTILEVER BRIDGE ACROSS THE EAST RIVER AT BLACKWELL'S ISLAND.—[See page 100.]



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NEW YORK, SATURDAY, AUGUST 10, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

AT LAST A 25-KNOT LINER.

Twenty-five knots an hour has for some time been recognized as the maximum speed which, in the present condition of the shipbuilders' art, it would be possible to secure in a big ocean steamship. Indeed, it was only when the marine steam turbine began to reveal its possibilities, that the creation of a 25-knot liner began to take shape in the mind of the naval architect. Congratulations are due to the Cunard Steamship Company, as being the first to place in service a ship of this maximum speed, particularly when it is borne in mind that to the distinction of being the fastest, the new flyer adds also those of being the largest, the most commodious, and the steadiest ship afloat.

In the "Lucania" and "Campania," now twelve years old, the possibilities of the multiple-expansion reciprocating engine for the development of high speed in ocean liners received a striking illustration, one of these ships having crossed the Atlantic at an average speed of slightly over 22 knots an hour. Then the German companies, with all the valuable data acquired in several years' service of these ships at command, and incorporating such improvements in engines and speed lines as their own undoubted talent suggested, brought out that magnificent quartette of boats, the "Deutschland," "Kaiser Wilhelm I.," "Kaiser Wilhelm II.," and "Kronprinz," the fastest of which added 1½ knots an hour to the transatlantic record, —the "Deutschland" and the "Kaiser Wilhelm II." having averaged 23½ knots an hour for the whole trip across the ocean. In their latest ship, the "Kronprinzessin Cecelie," a sister ship to the "Kaiser Wilhelm II.," the North German Lloyd Company, in spite of the fact that the two new Cunarders were under contract to develop a speed of 25¼ knots, decided, much to the surprise of a large section of the naval architects of the day, to equip their new boat, not with marine turbines, but with quadruple-expansion engines of the same type as those in the "Kaiser Wilhelm II.," of which they are practically a duplicate. The contract speed of the ship is the same as that of its predecessor, and she will be capable of equaling, if not somewhat exceeding, the 23½-knot average ocean speed of the sister ship.

That the "Lusitania" will be a 25-knot boat is now established by telegraphic dispatches from Liverpool, announcing that on the official trial, which lasted forty-eight hours, the ship maintained an average speed of 25¼ knots for a continuous run of 1,200 knots. This is certainly the most severe trial test to which any ship, either in the navy or the merchant marine, has yet been subjected. Considering that the engines are new, and the crew not yet accustomed to the ship, it is reasonable to expect that, after she has made a few voyages, the "Lusitania" will be able to maintain an average speed of 25½ knots under normal conditions of wind and sea. Steaming at 25¼ knots, however, she will bring the transatlantic record for the first time below five days—by just how much remains to be seen.

COLORADO DAM IS PERMANENT.

The sixty-foot dam which last winter was thrown hastily by the engineers of the Southern Pacific Railway across the break in the Colorado River banks, was recently subjected to a prolonged and searching test, through which it has passed most successfully. For over three weeks this work and the levees on either side of it were subjected to the greatest June flood on record, without developing any sign of weakness. The engineers, in spite of the violence of the flood, had no fears for the safety of the dam itself, but they realized that there was a possibility of the water passing around the end of the levee and attacking the canal in the rear. Fortunately, however, the Colorado River itself averted that danger, by deepening its old channel, and swinging it over away from the dam to the Arizona shore. The absolute safety of the dam against overflow was shown by the fact that at the period of highest water, the lowest point of the structure was always seven feet above high-water mark.

In anticipation of emergencies, the Southern Pacific Company, to whose prompt action is due the credit for the successful closing of the river, have built a railroad along the crest, from the head gate to the end of the levee. A telephone runs the entire length, with stations a mile apart. During the time of high water, men patrol the work on gasoline track velocipedes, so that if there is any indication of weakness, they can telephone to the heading, where a trainload of rock stands ready to be rushed to the breach. Although the break of the banks has been thus permanently repaired, water is still flowing into the Salton Sea by way of New River, passing down the Paradones to Volcano Lake, whence a portion of it flows northward through New River to the Salton Sea. This inflow, which is about 1,500 second feet, serves to compensate for the surface evaporation of the sea and causes its level to remain about stationary. The security of the Imperial Valley, with its wonderfully fertile lands and many settlers, is thus assured, and the greatest credit is due to the engineers of the Southern Pacific Railroad for carrying through this hazardous and difficult work in so short a period and with results that will probably stand for all time.

IS RUSTING ELECTROLYTIC?

Among the many valuable contributions to knowledge by the United States Department of Agriculture, one of the most important is that which was made public at the recent meeting of the American Society for Testing Materials, in which were announced the results of an investigation which the society has been carrying on for many years past, to determine the causes of the corrosion of iron. The most radical statement contained in Dr. Cushman's paper is that oxygen is not the primary but merely a secondary cause in the rusting of iron, and that the best protection against rust is the use of chromic acid and its salts for the treatment of the iron—that is to say, one of the most active oxidizing agents known to chemistry will be found to be one of the best preventives of rust. Startling as this assertion is, the experimental work, and the deductions therefrom, which have led to this conclusion, have been accepted by the leading specialists in this field of investigation. A notable indorsement of the paper was that by Dr. Charles B. Dudley, who did not hesitate to designate it as the most important contribution of the kind that has been made in the last twenty-five years. The investigation which resulted in this important discovery was undertaken with the object of discovering some method of preventing the corrosion of wire fencing—a subject of most vital interest to the farmers of this country. Hitherto, it has been commonly held that the formation of rust was due to the action of carbonic acid, resulting in the formation of carbonate, which, in its turn, is acted on by water and the oxygen of the air in the formation of rust or red hydroxide, the carbonic acid being set free by this last reaction to carry on again its work of destruction.

According to Dr. Cushman's theory, the first attack on the iron is made by hydrogen in the form of the hydrogen ion, and not, as the text books have taught us, by oxygen. This is in agreement with the modern theory that many substances, when they are dissolved in water, are dissociated into ions, or atoms carrying static electrical charges. Even pure water contains a certain number of these, and the presence of acid impurities multiplies the hydrogen ions and strengthens them in their corrosive effect upon iron. The action is explained as being purely electrolytic, and as involving an exchange of the electrostatic relations between the hydrogen and the iron. Dr. Cushman discovered that active oxidizing agents, such as the chromate and bichromate of potash, prevent rusting by polarizing the iron to the condition of an oxygen electrode, thereby safeguarding it against attack by the hydrogen ion. He found that by immersing the iron in a concentrated solution of bichromate acid, and then washing and wiping it, the metal is rendered passive, so that it becomes capable of resisting electrochemical attack. The action of rusting is completely analogous to that which takes place if iron is placed in a copper salt solution. In this case, copper ions, carrying positive electrostatic charges, are present; iron passes into solution and assumes the electrostatic charge, while the copper plates out and becomes visible. Correspondingly, when rusting takes place, iron passes into solution, while hydrogen plates out. Once in solution, the oxygen of the air oxidizes the iron to the insoluble form of the red hydroxide commonly known as rust. It would be difficult to overestimate the practical value of the discovery here outlined, which will have a most important bearing, not alone upon the structural work of the civil engineer, but also upon many forms of iron and steel construction included in mechanical engineering.

CAUSE AND CURE OF SPLIT RAIL HEADS.

Apropos of our reference to the meeting of the American Society for Testing Materials, mention should be made of the paper of Dr. P. H. Dudley dealing with steel rail sections. Probably there is no one in the United States, if indeed in the world, who speaks with such authority upon this subject. The doctor makes his home in a special car equipped with apparatus for determining the condition of the track over which the car is drawn, and the voluminous records which have been thus obtained are probably the most valuable practical contribution to our knowledge of the action of traffic on track, in existence. Dr. Dudley has ever been an ardent advocate of the use of rails of greater weight and deeper section, and in the paper referred to, he shows how great is the benefit secured from a comparatively slight increase in the height of the rail sections, in the way of giving a better distribution of the concentrated wheel loads. To raise the bearing surface of the rails from ½ to 1½ inches higher above the crossties than that of the earlier sections may seem a small increase, in the sense of dimensions; but when this slight increase is utilized in the design of the sections of rails, with a corresponding increase in the proportions of metal used, the mechanical advantages obtained in the way of enabling the rails to better carry and more broadly distribute the heavier modern wheel loads, represent an increase in the capacity of the rails of from 50 to 200 per cent. The depression of the deeper and stiffer rails, in spite of the increased wheel loads, is only from ⅛ to ⅜ of an inch, as compared with a ⅝ to 1 inch deflection under the earlier light and limber rails. The stiffer rail, moreover, has the advantage of distributing the wheel loads over a wider surface of track. The small bending resistance of the limber rail permitted the effect of the load to pass directly to the tie immediately beneath it, with the result that the crushing down of the tie occurred early in its life. The deep 5 and 6-inch rails, because of their high bending resistance, distribute the wheel loads among several adjoining ties, with a consequent lessening of the cutting action and a prolongation of their life.

Although wheel loads have increased only 100 per cent as against an increase in the stiffness of the rails reaching as high as 200 per cent in some cases, there has been a great increase in the number of breakages of rails in the corresponding period. Dr. Dudley has always attributed, and does so in this paper, the inferior quality of the rails to the hurrying-up, which has taken place in late years, of the process of manufacture, and particularly that part of it which has to do with the "blowing" of the metal in the converters. Sufficient time is not allowed to elapse, after recarburizing the blown metal, for the complete chemical reactions to take place, and for the slag to escape from the body of the metal. The slag, oxides and gases are often entrained instead of being eliminated, the chemical reactions being only partially completed while the steel is setting in the ingot mold. The slag and occluded gases, coupled with the segregated metal, are important factors in causing the heads of rails to split. The split rails develop after shorter or longer periods of service, the life of the rail depending upon the thickness of good metal between the surface of the rail head and the slag and occluded gases contained in the body of the rail. Split heads are not confined entirely to the rails rolled from the top of the ingot, but are found in less numbers in rails which have been formed from the body of the ingot.

Dr. Dudley proves his contention by quoting the composition and processes of manufacture of certain 80-pound and 100-pound section rolled for one of our leading railroads, and giving the excellent results obtained with these rails in service. The composition of these 80-pound rails as rolled for the New York Central was: Carbon 0.55 to 0.60, manganese 1.00 to 1.20, silicon 0.10 to 0.15, phosphorus not to exceed 0.06, sulphur not to exceed 0.07. The copper, which was not specified, averaged in those rails 0.7 to 0.8. The iron was remelted in cupolas, and the temperature of the heat in the converter regulated by 1,800 to 2,000 pounds of scrap, charged before the receipt of the molten iron. The bath was recarburized in the converter and the metal poled in the ladle by thrusting in a green wood pole. It was one or two minutes before teeming of the ingots commenced. The ladle nozzle was 1⅛ inches in diameter, and 6 or 7 minutes was consumed in pouring the 10-ton heat in five ingots, 15 by 15 inches square on the base and of sufficient length for three 30-foot rails. The ingots

were charged into horizontal furnaces, rolled direct in 13 passes, 3½ minutes from first blooming to the finishing pass. The hot rails were sawed ½ inch longer than for present practice, and spaced 6 inches apart on the hot beds, and turned after recalescence of the head.

Five hundred thousand tons of rails of that character were made, with the exception that for the 100-pound sections the carbon was raised 5 to 10 points and the manganese about 10 points higher than for the 80-pound rails. To date only 18 specimens are known to have developed what may be termed split heads, or "piped rails," as generally understood by the latter term.

The rails from the ingots were lettered "A" for the top rail, "B" for the second rail and "C" for the third. These letters can be found in the tracks, and as would be expected, the "A" rails have a larger percentage of impurities than the "B" or "C" rails. They wear faster, developing more surface defects, and at several points upon the road, under heavy traffic, after 10 and 12 years' service, have become practically worn out for main line traffic, while the "B" and "C" rails are still good.

RAMSAY'S DISCOVERY OF THE DEGRADATION OF COPPER TO LITHIUM.

Sir William Ramsay has recently made an announcement which, coming from so high a source, must be treated with respect and which, if borne out, must rank with his famous discovery of the transformation of radium emanation into helium. He states that after long experimenting with the effect of various combinations brought into contact with radium emanation, he has observed that copper compounds are transmuted or "degraded," in his own words, to lithium. After a solution of copper phosphate has been treated with the emanation and the copper then removed, the spectrum of the residue exhibits the red line of lithium. According to newspaper interviews, the experiment has been repeated so often with so many precautions, both with copper nitrate and copper sulphate, that there can be no doubt of the correctness of the observation. Other nitrates were experimented with and no lithium line was observed, nor was it possible to obtain the lithium line before the solution of copper phosphate was brought into contact with the emanation. According to Sir William, the only conclusion to be drawn from these observations is that the copper acted upon by the emanation has been degraded to the first member of the group of elements to which it belongs, namely lithium. A full report will be made at the end of August, in the Transactions of the Chemical Society, and until that report is published, it is inadvisable, and indeed impossible, to discuss with any degree of thoroughness a discovery which, if substantiated, must certainly be regarded as one of the most brilliant chemical revelations of this radio-active age.

THE STORY OF AN ANCIENT MINE.

BY HERBERT W. HORWILL, M.A.

The modern graduate of a technical school who has specialized in mining would probably be able to give a satisfactory list of the most important recent publications on his own subject. It is not so certain that he would be ready with an answer to the question: What is the earliest recorded description of mining operations in the literature of the ancient world? He would naturally excuse his ignorance by the plea that the scientific portions of the ancient classics are of no practical service to-day, and that, such as they are, they belong properly to the domain of the philologist or the antiquarian. As it happens, the passage in question does not occur in a technical book or indeed in an out-of-the-way and obsolete volume at all, but in a poetical composition which is easily accessible, which is still read by a large number of persons, and which is supposed to be more or less familiar to every man possessing a fair general education—the Book of Job.

The fact that this most interesting passage is so little known is largely due to the obscurity of its translation in the Authorized Version. One might easily read through the twenty-eighth chapter of Job in that version without the least idea that it contained a detailed account of the processes by which the miner earns his livelihood. The first two verses, it is true, point to something of the kind, but at the third the writer appears to diverge into a not too intelligible panegyric of Divine omnipotence as shown especially in floods and earthquakes. Turn to the Revised Version, and the puzzle at once becomes a picture. From the first verse to the eleventh inclusive we are now able to follow an exact description of the methods employed by the ancient miner, and still pursued in the main wherever there is discovered a deposit worth working.

The key to the whole interpretation is in the meaning of the word "he" in the third verse. In the old version it appeared to denote God; the Revisers apply it to man. Accordingly, the passage refers not to Divine omnipotence but to human enterprise. "Man," we read, "setteth an end to darkness, and searcheth out to the furthest bound the stones of thick darkness and of the shadow of death." Here we see the miner with his lantern bringing light into a region hitherto sealed from man's gaze and searching not only near the surface, but, as "stones of thick darkness" seems to indicate, the very gloomiest recesses of the earth's interior.

"He breaketh open a shaft away from where men sojourn; they are forgotten of the foot that passeth by; they hang afar from men, they swing to and fro." This is severely scientific, but it is poetical also. As Dr. Samuel Cox has said, the writer brings out, in a few deft strokes, "the pathos of the miner's life and occupation—its peril, its loneliness, its remoteness even from those who stand nearest to it." The ancient poet had probably in his imagination the wilderness of Arabia Petræa, but the same feature of distance from crowded cities has usually been a characteristic of the beginnings, at any rate, of a great mine, whether in California, or in Nevada, or in Australia. And even if it is not so utterly remote from human habitation, the casual passenger goes on his way ignorant or oblivious of the burrowing far beneath his feet, where the miner "hangs" or "swings" at his work, having been lowered to the desired spot by some primitive cross-bar slung between ropes or chains.

The picture is now relieved by a suggestive parallel. The earth, on its surface as well as in its recesses, contributes to the welfare of man and supplies a sphere for his industry. "As for the earth, out of it cometh bread: and underneath it is turned up as it were by fire." Man, the worker and magician, both cultivates the soil that it may yield him his food, and pierces far below in quest of its hidden treasure. The second clause of the verse is generally interpreted as a reference to the Egyptian method of removing ore by "fire setting," i. e., by lighting a fire at the base of the rock to be removed so that the heat might split the harder portions and make cracks in which a chisel or pick could be inserted. The value of the miner's finds is next indicated. "The stones thereof are the place of sapphires, and it hath dust of gold," or, as the marginal rendering gives it, "he winneth lumps of gold."

There follows a graphic contrast between the boundless ingenuity of man and the limited sagacity of the brute. "That path"—the road which the miner hews out for himself—"no bird of prey knoweth, neither hath the falcon's eye seen it: the proud beasts have not trodden it, nor hath the fierce lion passed thereby." Man's detection of the secret gems of the earth is keener than the acutest predatory instinct of hawk or vulture. His strength in pursuit of his spoil excels that of the tyrants of the jungle or the forest. For "he putteth forth his hand upon the flinty rock; he overturneth the mountains by the roots."

The last phase of the description reminds us of the cleverness of the underground explorer in preserving himself and his operations from disaster, and of the persistent thoroughness of his investigation. "He cutteth out channels among the rocks; and his eye seeth every precious thing. He bindeth the streams that they trickle not (Heb., from weeping); and the thing that is hid bringeth he forth to light." The miner is here depicted as using mechanical expedients for preventing leakage through the roofs or walls of the passages in which he works, and as cutting canals to drain away water that may have percolated through. An alternative explanation of "he bindeth the streams from weeping" is that a reference is intended to the damming up of the waters in the river while the auriferous alluvial gravel is dug out. In either case the result is that nothing escapes his scrutiny, and that his energy and skill are rewarded by the discovery of the riches he seeks.

The whole passage is thus a striking poetical representation of the art of mining as practised in early times, and, except for the absence of elaborate machinery and powerful explosives, as still carried on to-day. And it is a picture with a purpose—to impress us with the wonders wrought by human enterprise so far exceeding the utmost marvels of animal instinct. As we read further on in the chapter, we find that this exulting tribute to the achievements of man is introduced into the poem that it may emphasize the limitations of even his intelligence. The close of the above description is immediately followed by the question: "But where shall wisdom be found? And where is the place of understanding?" There are some darknesses of which man cannot make an end; some priceless treasures that baffle even his research. Wisdom and understanding, of far greater worth than rubies, are neither to be purchased by the gold the miner discovers, nor are they to be attained by the exercise of his most penetrating ingenuity.

The date of the book in which this remarkable passage occurs is by no means a settled question among Biblical scholars. The traditional view which ascribed its authorship to Moses is now generally abandoned. The majority of modern critics place it somewhere between the seventh and the fourth century B. C., so it may be accepted as of a sufficiently remote period to make its description of the mine one of the earliest, if not absolutely the earliest, to be found in any literature. The four metals mentioned in the beginning of the chapter—silver, gold, iron, and brass (or rather copper, as a more exact translation would render it)—are those which were discovered and worked in the first ages of which we have a record. It is thought that the writer of this book was best acquainted with the mining operations of the Egyptians, who worked gold and silver mines in upper Egypt, and copper and turquoise mines in Arabia Petræa or the Sinaitic peninsula. There were no mines in Palestine itself, which explains the fact that this is the only reference to them in the Old Testament. The Egyptian copper mines in the Sinaitic mountains are known to have been carried on successfully as far back as the times of the early Pharaohs. Shafts, slag-heaps, smelting-places, and other distinct relics of the working of these mines may be seen to this day in some of the "wadis," or channels of dried watercourses. Many of them appear to be in the same condition in which they were left by the Egyptian workmen four or five thousand years ago; "the very marks of their tools," it is said, "being so fresh and sharp in that pure dry atmosphere, that more than one traveler has felt, while looking at them, as though the men had but knocked off work for a spell and might come back to it at any moment."

SCIENCE NOTES.

There is something about a holly hedge that challenges the destructive instinct in mankind. John Evelyn, the diarist, had one of the finest in England in the grounds of his home at Deptford, and Peter the Great ruined it for him. That extraordinary czar, when he came to the docks to learn shipbuilding, took a tenancy of Evelyn's house. Whenever he felt in need of relaxation he sat down in a wheelbarrow and caused a servant to charge with it at the holly hedge as hard as he could go. Also he cut up Evelyn's fine lawn most terribly by "leeping and shewing of trikkes" with his suite. Altogether, he did not do the house or garden any good. But the owner could get no adequate compensation.

There is a passage in Pliny that is usually cited as evidence that something akin to spectacles must have been in use at least in his time. He relates that the Emperor Nero used a precious stone which he calls "smaradgus," generally translated "emerald," through which he was accustomed to gaze on the gladiatorial combats; or rather, this is what he seems to say. There is, however, little doubt that Dr. Magnus, the latest author to examine the passage critically, is right in holding that it means no more than that the emperor was in the habit of gazing upon an emerald which he used to carry with him for the purpose of resting his eyes when they became tired looking upon shows that were interesting to him. This view is rendered the more probable from the belief of antiquity that green has a restful effect upon the eyesight.

M. De Morgan, the eminent French archæologist who has been carrying on excavations at Susa within recent years, made a communication to the Académie des Inscriptions et Belles-Lettres upon the results of the excavations which were undertaken from 1906 to 1907. Some important finds were made in the recent excavations at Susa. Among the objects which were found, we may mention especially a statue of alabaster which dates from a period about 4,000 B. C. It represents the king Manichtusu, and is claimed to be one of the oldest statues found in Asia. At the same meeting M. De Morgan showed a number of specimens of a very handsome variety of pottery which comes from about the same epoch as the statue. He is of the opinion that this pottery, together with the prehistoric pottery of Egypt, is the ancestor of the ceramic art in the Mediterranean region.

Some experiments have been made by A. Blanc, a German physicist, upon the decomposition of radio-thorium. The previous work of Hahn upon radio-thorium taken from the mineral thoriante, showed a diminution of activity, but did not give the rate at which this takes place. The author made his tests upon a preparation which showed an activity 3,000 times as great as the same weight of hydrate of thorium. There were no traces of radium in this compound. It was obtained from the Echaillon deposits by Dr. Angelucci. Measuring the loss of activity from day to day for 251 days, he finds that after a first rapid diminution, the rate becomes nearly proportional to the time. On the 251st day it had reached 71.4 per cent of the normal value. He estimates that an atom of this substance has a duration of 1,064 days, and that half the atoms will be decomposed in 737 days. It is thus found to be the radio-active body for which the activity falls to one half in the greatest time. Polonium, or F-radium, which seemed to have the greatest value, shows a period of 143 days to read half the figure for the activity. The author shows besides that the substance radio-thorium is actually a product of the transformation of thorium, for otherwise we could not explain the constant activity of salt of this body. This opinion is upheld by other scientists.

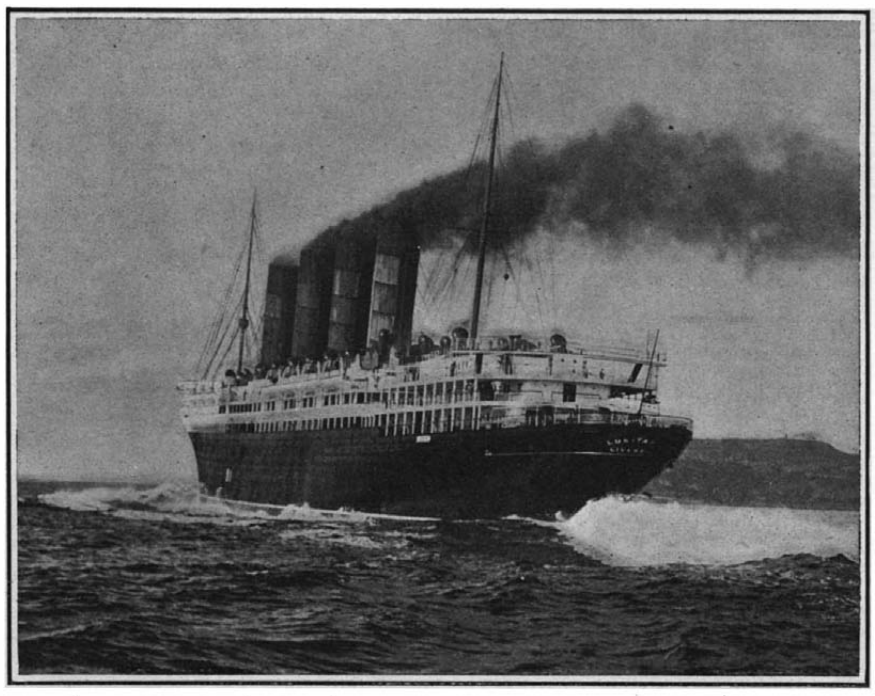
THE 25-KNOT TURBINE LINER "LUSITANIA."

Everyone who is interested in the advancement of the art of shipbuilding will be gratified to learn that on a preliminary speed trial of the new turbine liner "Lusitania" of the Cunard Line, the great ship easily reached a speed of 25 knots, and this in spite of the fact that her bottom was "heavily coated with the chemically-saturated mud of the river Clyde." The data obtained, under these conditions, of the measured mile runs, were verified on her subsequent official acceptance trials, when she maintained the contract speed of 25¼ knots an hour, over a course 1,200 miles in length, on which she steamed continuously for forty-eight hours.

The accompanying photographs, taken during this acceptance trial, will give an impression of the great proportions of this ship. A study of the wave-lines proves that for her size and speed, she presents a remarkably small wave-making resistance. This is due, of course, to the fine form of the underbody. From the point of view of the traveling public, perhaps the most important point developed by these trials was that, at 25 knots an hour, the new Cunarders will be free from vibration.

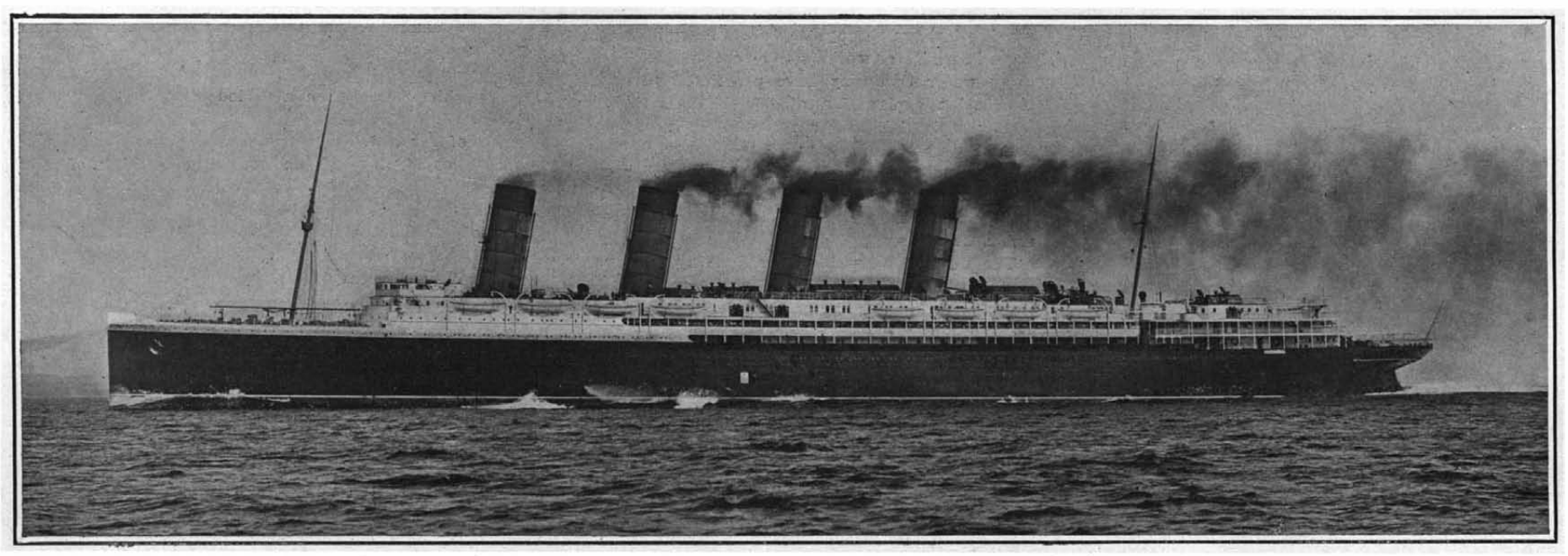
It is no exaggeration to state that the new liners mark the most important advance in size and speed which has ever been made in the history of steam navigation—always excepting, of course, Brunel's giant ship, the "Great Eastern." With all due deference to the "Lucania" and "Campania," and the splendid ships of the German companies, the "Lusitania" and "Mauretania" may be said to be in a class by themselves. With an indicated horse-power which will probably work out at 80,000, with a displacement of 45,000 tons, and a probable speed, ultimately, of 25½ knots, these vessels, in comparison with the finest of the express steamers, are found to be about 50 per cent larger, 2 knots faster, and of double the horse-power of their nearest competitor. The great breadth of the "Lusitania," of 88 feet, has enabled the company to provide staterooms of 50 per cent more capacity than those found on existing steamships. The promenades, also, are wider and longer, and these facts, coupled with the absence of vibration, will do much to increase the comfort of transatlantic travel.

As these ships have been built with government assistance, they have been so designed that they may be quickly converted into fast cruisers, capable of overtaking any merchant or war ship afloat. Each vessel will be armed with twelve high-velocity 6-inch guns, and will be considerably protected by the great depth of her coal bunkers. Hence they would be capable of putting up a stiff fight against any protected cruiser which they might encounter. The constructive features of the ship are novel, and because of her mammoth proportions are of unusual interest. The keel plate is 5 feet wide and 3¾ inches thick. The double bottom, covering the whole of the ship's length, is 5 feet in depth. There are nine decks in all, and the hull is divided into 175 separate water-tight compartments, which, surely, establishes the claim that she is unsinkable by any ordinary disaster. Into the construction of the hull entered 26,000 steel plates, the largest of which are 48 feet in length and weigh 4½ tons apiece. The main frames and beams which form the skeleton of the ship would, if placed end to end, extend for a distance of 30 miles. To rivet the plating upon the beams required 4,000,000 rivets, whose aggregate weight is 500 tons. The rudder weighs 65 tons, and the castings for the stem, stern-post, shaft bracket, and rudder, together weigh 280 tons. The ship carries three 10-ton anchors, and 1,800 feet of cable, the links of which measure 24 inches and are forged of 3¾-inch iron. From the keel to the roof of the pilot house, the "Lusitania" measures 100 feet; and at her full draft of 37 feet 6 inches, she will displace 45,000 tons. Each of the four funnels is 24 feet in diameter and extends 155 feet above the grate-bars of the furnaces. The extreme length of the ship over all is 790 feet; the breadth, 88 feet; and the plated depth, 60 feet. The "Lusitania" will accommodate 2,200 passengers; and as she will carry a crew of 800, her total complement is 3,000 souls.



Stern View of the "Lusitania," Showing Her Great Beam. Note the Very Slight Wave-Formations.

The designed horse-power is 70,000; but it is invariably the case that a marine turbine, when pushed to its full limit on a trial trip, shows an output considerably in excess of the estimate, and it is likely that in the forthcoming trials, the horse-power will work out at nearer 80,000 than 70,000. The power is developed on four shafts, the outer pair of which are driven by high-pressure turbines, and the inner by low-pressure. Steam is supplied by 25 boilers, carrying 192 furnaces. With a coal consumption at the rate of 1.3 pounds per horse-power per hour, the "Lusitania" will consume about 45 tons of coal per hour, or say about 1,100 tons per day. Hence, she must stow in her bunkers, for a single trip, not less than about 7,000 tons of coal. The fact that the Cunard Company installed turbine engines in the "Carmania," and that they have had the advantage of some two years of observation of this ship, has been of great assistance in the working out of the designs for the turbine motive power in the new ships. The engineering world has been watching with great interest for the publication of the fuel consumption and other valuable data of the "Carmania's" turbine engines; but up to the present time, the company has not seen fit to make these public. We understand, however, that this consumption compares favorably with that of the sister ship "Caronia," which is equipped with reciprocating engines, and is known to be a highly economical vessel. There is one feature in the turbine problem which augurs favorably for the economy of the new Cunarders, namely, that the marine turbine shows increasing fuel economy as the speed is increased; and since these vessels will never steam at less than 24 knots, they should prove to be easy on steam consumption. The work of constructing the turbines has been tedious and costly. The casing of the low-pressure turbine is an enormous casting, the finished internal diameter of which is 16½ feet. All of the turbines taken together call for the separate fitting and alignment of no less than 3,000,000 blades.



Length, 790 feet. Beam, 88 feet. Depth (plated), 60 feet. Displacement, 45,000 tons. Speed, 25¼ knots.

THE TURBINE CUNARDER "LUSITANIA" MAKING 25¼ KNOTS ON HER 1,200-MILE TRIAL TRIP.

The New British Battleships.

In the two new battleships which are to be laid down for the British navy in accordance with the current year's programme, a departure from the policy adopted in regard to the armament of the "Dreadnought" is to be effected. While of the same class and type, they will be 2,000 tons heavier, their displacement being about 20,000 tons. In regard to the main armament, there will not be so many weapons of the larger caliber, though they will be much heavier, a new 13.5-inch weapon which has been severely tested being adopted in the place of the 12-inch. This gun fires a shell weighing 1,250 pounds as compared with the 850-pound shell of the 12-inch arm. Moreover, a secondary battery of medium quick-firing guns is to be carried, a feature which is entirely absent in the "Dreadnought," and which deficiency has been severely criticised. The effect of this modification will be that the new vessels will have an aggregate broadside fire of some 8,500 pounds as compared with 6,800 pounds in the "Dreadnought." These two vessels are to be laid down at once at the Portsmouth and Devonport dockyards respectively, and they will each cost over ten million dollars. At the present time the armament firms in the country are working at full pressure to deliver the present order of 12-inch guns for the navy's immediate requirements, no less than 120 of these weapons being in course of construction.

Wound Sucking in Ancient Times.

That ancient customs are still practised by primitive tribes is interestingly shown by the two following incidents. In the Iliad we are told that when Asklepias "saw the wound where the bitter arrow had lighted he sucked out the blood," and so forth. In his recent work on the Australian aborigines, John Mathew informs the reader that the doctor or sacred man made a practice of sucking the part affected. He then proceeds: "There seems to be some efficacy in the sucking, for a friend of mine who was suffering severely from an inveterate, inflamed eye allowed a black 'doctor' to mouth the eyeball, and the result of the treatment was immediate relief and speedy cure." A further parallelism between the rise and practice of the healing art and the priestly class, although in Greece the connection was less close than elsewhere and did not long continue, is shown by this extract.

THE INTERNATIONAL KITE ASCENSIONS.

BY S. P. FERGUSSON, OF THE BLUE HILL METEOROLOGICAL OBSERVATORY STAFF.

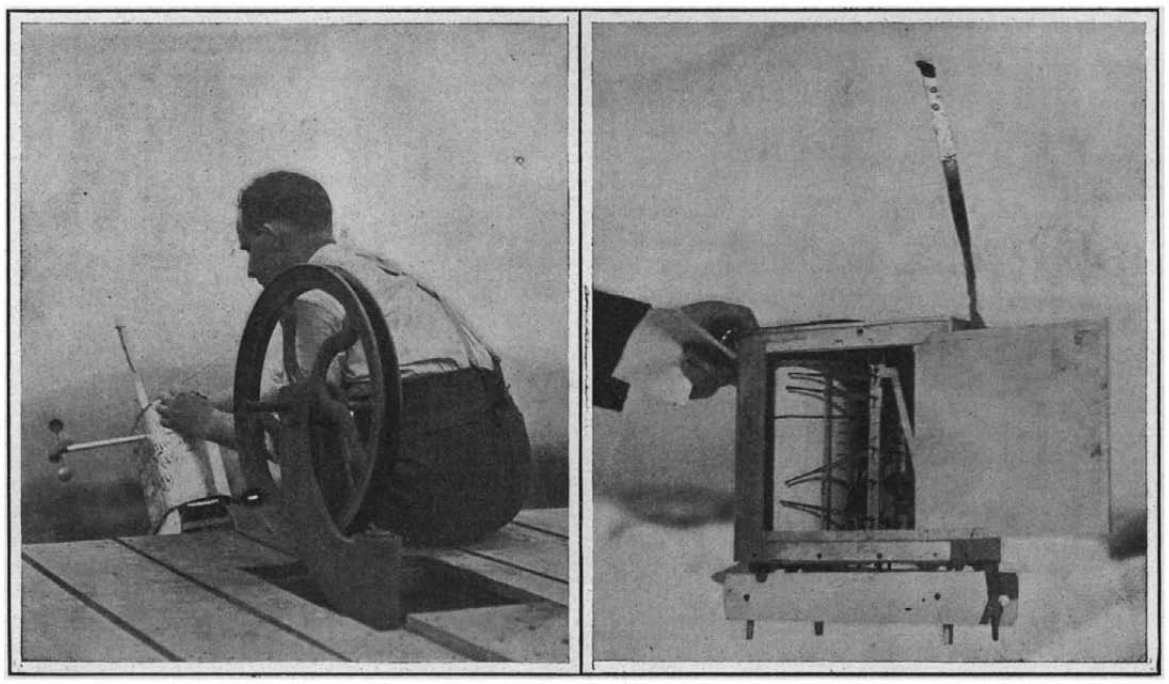
At the present time the rapidly increasing attention given to the science of aeronautics is manifested not only in experimental study of aerial navigation, but in the use of aeronautical apparatus, such as balloons and kites, in systematic studies of the atmosphere. Much interest has been shown in the international balloon and kite ascensions made during the week ending with July 28, and as the purpose of this work does not appear to be very generally understood a brief account thereof will be given in this paper.

The successful introduction of the *ballon-sonde* (or unmanned balloon carrying registering instruments only) in 1892, and the application of the modern kite in 1894, gave a great impetus to meteorological research and it is easily understood that there should be uniform rules for the employment of these methods.

M. Wilfred de Fouvielle, of Paris, whose valuable co-operation in the first experiments with *ballons sondes* is well known, was the first to propose international co-operation in the exploration of the air, and at the International Meteorological Conference in Paris in September, 1896, at the instance of members interested in meteorological aeronautics the following resolutions were adopted by the assembly:

"1. The Conference recognizes the great importance of aeronautical investigations for meteorological science and expresses the desire that scientific ascensions should be encouraged and multiplied.

"2. The Conference expresses the wish that scientific ascents, either with manned balloons or with pilot balloons, should take place simultaneously at the different stations.



Mr. Fergusson Fastening a Meteorograph to a Kite Line.

A Meteorograph Which Records Temperature, Humidity, Wind Velocity, and Height.

"3. At the present time the Conference cannot recommend either special methods or particular instruments, but it desires that, so far as possible, identical instruments should be used during the simultaneous ascensions of pilot-balloons.

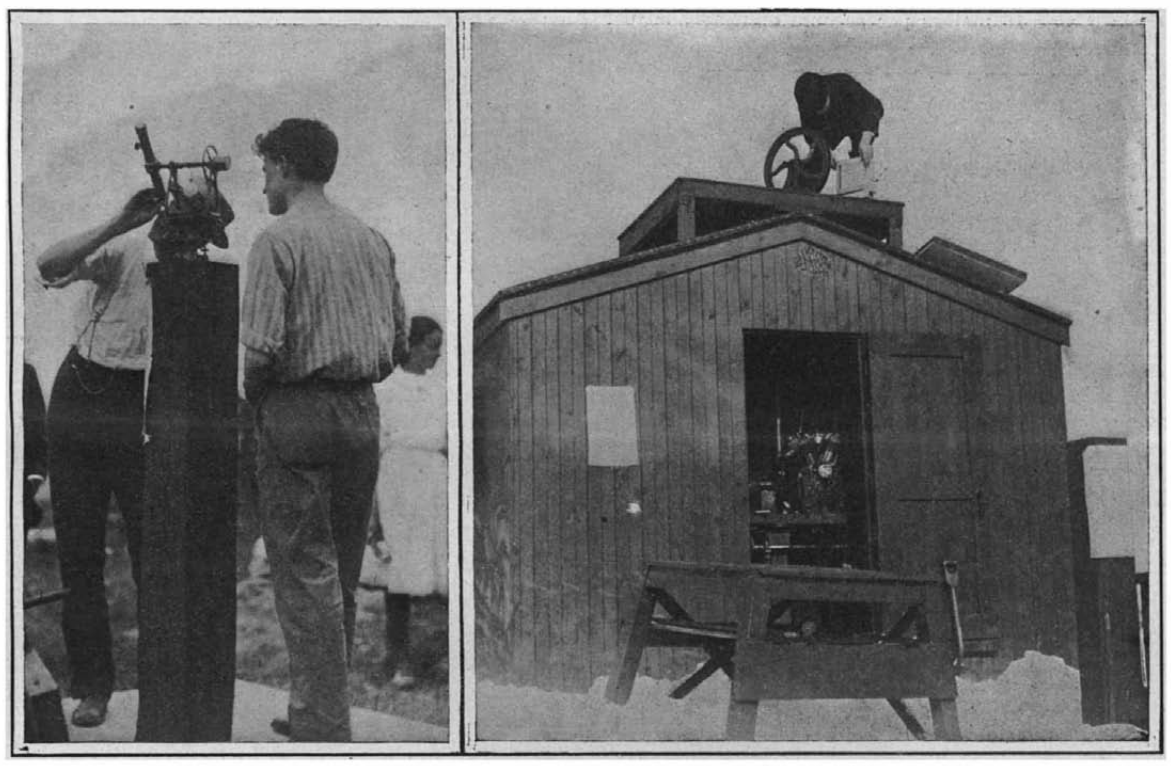
"4. The prompt publication of the unreduced observations, especially those which are made in simultaneous ascensions, is of capital importance.

"5. It is desirable that observations in captive balloons, which are not manned, should be systematically made.

"6. On account of the satisfactory results which have been attained at Blue Hill with kites carrying registering instruments up to 2,000 meters, it is desirable that similar investigation be undertaken elsewhere."

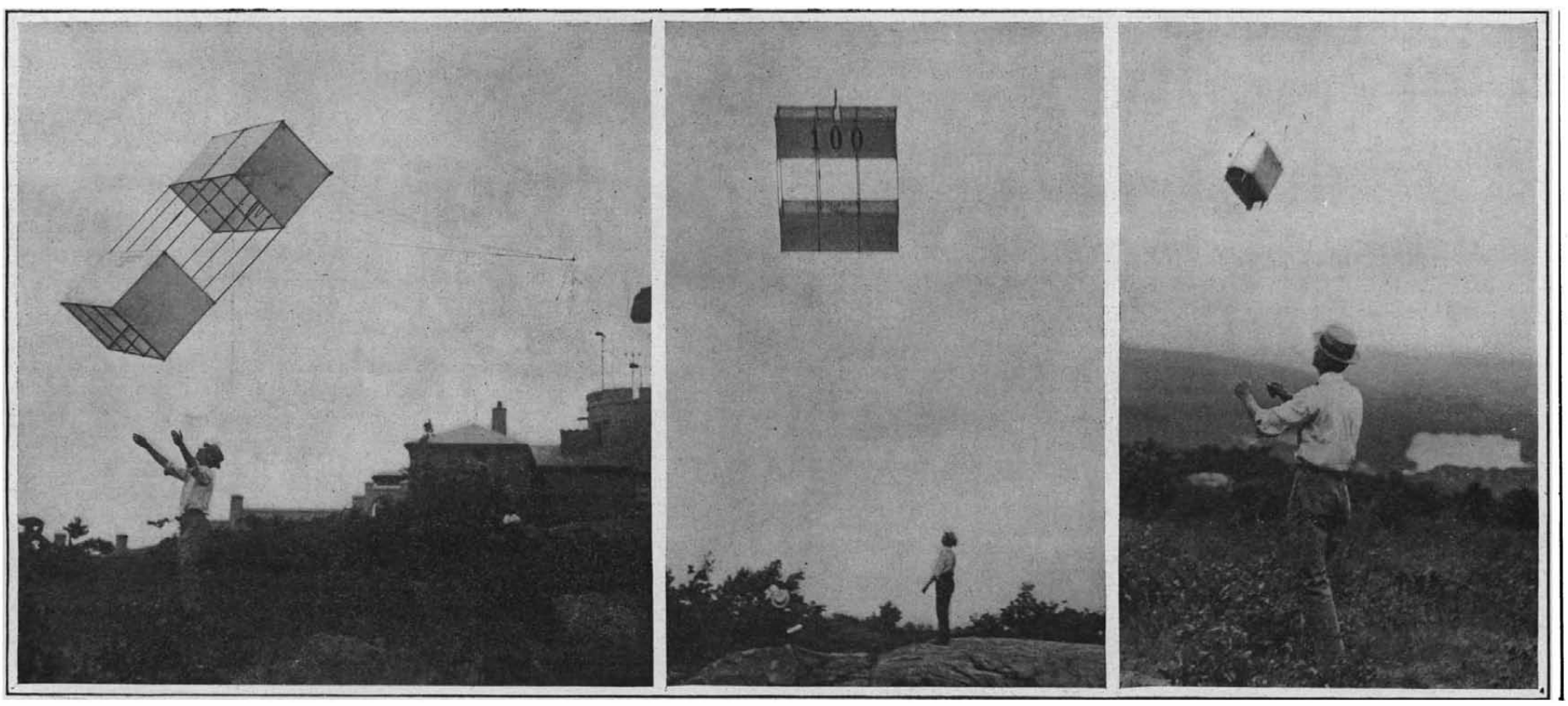
Afterward, to further these resolutions, the following provisional aeronautical committee was named by the International Committee: MM. Hergesell, Erk, and Assmann, of Germany; Cailletet, de Fouvielle, Hermite, and Jaubert, of France; Pomortzeff, of Russia, and Rotch, of the United States. Later, the International Commission for Scientific Aeronautics was organized, consisting of persons actively interested in scientific aeronautics and having for its object the investigation of atmospheric conditions up to the highest limits attainable with kites and balloons. Prof. Hergesell, chief of the weather service of Alsace-Loraine, was elected president. Meetings of the commission were held once in two years until 1906, when it was voted to meet once in three years. The Permanent International Aeronautical Committee was founded by a resolution of the International Aeronautical Congress held at Paris in 1900, in order to carry out the expressed wish of the Congress to advance the progress of aeronautics by scientific advice and the study of methods and apparatus. The members are prominent aeronauts, engineers, and meteorologists, chiefly from European countries. The American members are Prof. A. L. Rotch, director of Blue Hill Observatory, and Mr. Octave Chanute, of Chicago.

The practical work of the International Commission began shortly after its organization with simultane-



Measuring the Altitude with the Theodolite.

Fastening a Meteorograph to a Kite Wire.



Starting a Flight.

Box Kite Traveling Upward.

Catching the Meteorograph on Its Descent.

THE INTERNATIONAL KITE ASCENSIONS.

ous ascensions of manned and unmanned balloons at six European stations, but it has expanded until at the present time about twenty institutions and individuals co-operate in making ascensions, usually on the first Thursday of each month and occasionally on several successive days predetermined by the International Committee. Among the co-operating institutions are the famous Prussian Royal Aeronautical Observatory, where ascensions have been made daily for several years; the Deutsche Seewarte at Hamburg; the Observatoire de Météorologie Dynamique at Trappes, France; the Blue Hill Observatory, and the Mount Weather Observatory, the last two being the only institutions co-operating in the United States. The records and observations obtained are forwarded to the headquarters of the commission at Strasburg, and published in the Veröffentlichungen der Internationalen Kommission für Wissenschaftliche Luftschiffahrt, which is edited by Prof. Hergesell.

Kites.—At all of the co-operating stations some modification of Mr. Clayton's form of the Hargrave kite has been employed almost exclusively. Apparently, no other has been found to possess the strength, stability, and efficiency necessary for continuous experimenting in all conditions of wind and weather, although many efforts have been made to develop a kite less complex and less expensive to construct.

The kites usually employed weigh from 350 to 850 grammes per square meter of lifting surface, which varies from 3 to 7 square meters, according to the size of the kite. Generally, they are made with flat lifting surfaces and when secured by a short line fly at an altitude of 53 to 57 deg. The practice, followed at Blue Hill and Berlin, of employing rigid curved lifting surfaces in the front cell increases the weight slightly, but there is a great gain in efficiency, the altitude reached averaging between 60 and 66 deg. The kites are sometimes made to fold up, which is very advantageous when broken parts are to be replaced or the kites are to be moved a long distance.

Line.—Steel music wire only is employed for the main line and in some instances this material has been substituted for the flexible cables and blocking cord heretofore employed for secondary lines. The plan, first adopted in 1891 by William A. Eddy, of New York, of making the main line of pieces of different sizes, the strength increasing from the outer end toward the reel, has been very generally employed.

Reel.—The reels employed vary considerably in design but, in most of those in use, the line is stored on a large drum whence it is drawn by the pull of the kites, and on which it is rewound at the end of an ascension, by means of a suitable motor. Devices are provided for registering the pull of the kites and the length of line in use, also in some reels strain pulleys are employed to relieve the storage drum of excessive pressure. Strain pulleys are injurious to the line and reels fitted with them can be operated only by skilled engineers; for these reasons they have been abandoned at Blue Hill. The highest efficiency is obtained when the reel is always under perfect control and can be started, stopped, or reversed quickly in response to any of the ever varying requirements of kite-flying.

Meteorological Instruments.—Most of the recording instruments now in use are modifications of the well-known Richard patterns, the more recent departures from the original construction having been made for the purpose of securing greater sensitiveness and smaller weight. Usually four elements—wind velocity, pressure, temperature, and humidity—are recorded. The instruments are frequently tested to determine the scale-values of the different elements and are always carefully compared with standards in suitable conditions of exposure before and after each ascension.

Observations.—The heights reached are mostly determined from frequent observations of the kites by means of a transit, except when the kites are hidden by clouds or darkness, in which cases the heights are obtained from the record of barometric pressure. Meteorological data are obtained at many different times and heights in order to ascertain progressive and non-periodic changes in each element as well as the distribution in a vertical direction. An immense amount of material is being accumulated for study and the discussion of this is adding very greatly to our knowledge of the processes of the atmosphere; also, in time, there is reason to expect practical benefits in the form of increased accuracy in forecasting the weather.

During the present year, in addition to the regular monthly ascensions, there were planned three groups of ascensions, one occupying six days ending with July 27, one of three days' duration in September and another in December. It is yet too early for news of the European ascensions, and, as the Blue Hill records have not been reduced, it is possible to give only a very general statement of the results. Kite flights were obtained on July 22 between 3:15 and 5:45 P. M. to a maximum height of 1,000 meters; July 24, 6:40 P. M. to 10:30 P. M., probable height 2,500 meters, but instrument was lost and has not been found; 26th, 3:20 to 3:40 P. M., 500 meters; 27th, 6 to 8:50 P. M., 2,000 meters; 29th, 2:30 to 6:30 P. M., 1,300 meters. On other days the conditions were unfavorable, chiefly because of calms, and no flights were possible. The records do not indicate any unusual or very remarkable phenomena unless we except the very high wind velocity (23 meters per second) recorded at a height of 2,000 meters on the 27th.

The International Commission also publishes observations made at mountain observatories, those of the Sonnblick, Brocken, Puy de Dôme, and others having co-operated. In this country Mount Weather (526 meters) and Blue Hill (195 meters) are the only mountain stations contributing records throughout the year. With the kind co-operation of Mr. Frank H. Burt, editor of Among the Clouds, the writer has obtained records on the summit of Mount Washington, N. H. (1,916 meters), during the international ascensions of August 29, 30, and 31, 1905, September 6, 1906, and July 22 to 27, 1907. These observations were undertaken primarily for the purpose of comparing the conditions on the summit with those of the free air by means of kites flown at Twin Mountain near by. The work of the last expedition to this vicinity having ended on July 20, Prof. Rotch co-operated in extending the kite flights to cover the week ending with the 27th and obtain comparisons during the International series of ascensions, the experiments being conducted by Mr. Clayton. Perhaps the most interesting result of this work is the confirmation of the first comparison of wind velocities on Mount Washington made in 1905, which showed a higher velocity on the mountain than existed in the free air. On July 20 the wind on the summit was 23 meters per second, while in the free air it was 16 meters per second, or nearly 30 per cent lower.

Engineering Notes.

A series of tests was recently made upon a steam turbine connected with a dynamo at the Schlesischen Kohlen und Kokswerken, in Germany, the turbine being designed to give 1,000 horse-power. The consumption of steam is found to be 7.98 kilogrammes (17.19 pounds) per kilowatt hour at full load on the dynamo, and 8.77 kilogrammes (19.63 pounds) per kilowatt-hour at half load. The steam worked under a pressure of 7.5 atmospheres, and was superheated at 300 deg. C. In the surface condenser the vacuum lay between 90 and 93.5 per cent. As regards the consumption of steam in the turbine, this was found by weighing the condensed water in the usual way. The momentary variation of speed which was due to a complete removal of the load (by cutting the current of the dynamo) was 5.5 per cent, and the permanent speed variations did not exceed 2.5 per cent under the same conditions. The variations of voltage on the dynamo without regulation of the current in the fields or of the speed of the turbine were found to be 11.6 per cent for a sudden discharge of the load, and 8.5 per cent when the load was abruptly thrown on. A test of an overload up to 952 kilowatts on the dynamo during a period of one hour gave very satisfactory results. The economy of steam realized by the use of the steam turbine instead of the former steam engines, reaches as high as 14 per cent at full load and 24 per cent at half load.

Sewage disposal works consisting of septic tanks and percolating filters have recently been opened at Macclesfield, England, in place of the chemical precipitation system formerly employed, says the Engineering Record. The tanks used for precipitation have been enlarged and others built, so that the total tank capacity is now equal to the dry-weather flow for one day. The septic sewage passes from them to four percolating filters, each 120 feet in diameter and of 6½ feet average depth. These filters have concrete floors somewhat inclined from the center toward the circumference for drainage purposes, and their walls are constructed of brick reinforced by four 2 x ⅛-inch steel bands. Headers have been admitted in the wall at frequent intervals for aeration purposes, and the openings at the floor level left in this way also served for drainage. Broken stone is used for the filtering material. The septic sewage is distributed over each filter by four revolving arms pivoted at a center pier and arranged to be driven by the head of the sewage as it reaches them or by an electric motor. The effluent from these filters is conducted to a secondary filter, 408 feet long and 107 feet wide, which consists of 1 foot 9 inches of broken clinker with a surface layer of fine pottery saggars, The effluent from the percolating filters is distributed over this bed by means of half-pipe channels on its surface and is drained from it through perforated pipe in the bottom. If so desired, the effluent from the secondary filter can be run over a tract of land, but ordinarily it will be discharged directly into a neighboring river.

Users of gas engines on a large scale are commencing to realize that the heat carried away by the exhaust from gas engines amounts to about one-third of the total heat generated, and that the exhaust gases, being at a temperature of about 1,000 deg. F., are capable of raising a large amount of steam, provided that a boiler suitable for the purpose is installed. According to the Railway and Engineering Review, such boilers are now being placed on the market. They should be placed as near to the engine cylinder as possible, and they consequently form a perfect exhaust silencer. When the gases have passed through the boiler they escape into the atmosphere by a pipe which is free from the usual nuisance of heat and noise. Inasmuch as gas power has not so far been favorably considered in many plants because of the need of the exhaust steam from steam engines for special purposes, there is now a chance for the adoption of the exhaust gas boiler to raise steam for heat or other purposes, while the motive power is gas, and thus a double measure of economy and usefulness is attained. In one factory in England these boilers are generating steam from the heat of the gas engine exhaust gases equivalent to the steam generated by 70 tons of coal per week.

The last link of the system of underground railroads promoted in London, England, by the late Charles T. Yerkes was opened to the public June 22. The new line, which connects the northern suburbs with the heart of London, is eight miles long. It was begun in 1903, runs on an average 60 feet below the surface, and cost $25,000,000. A party of financiers and officials attended the opening ceremony. The public was permitted to travel free during the afternoon and evening, and was given souvenirs of the opening of the road. The Yerkes idea of underground transportation for London is now fully realized. Moreover, the general trunk system which he projected has been supplemented until underground London is honeycombed with tubes giving quick and comfortable service in all directions. Mr. Yerkes' first work was to electrify the old steam, shallow railways extending up and down the Thames and around the crowded district on the central north. Then he built the Waterloo tube under the Thames, between Paddington station and the Elephant and Castle. This line cost $25,000,000 to construct the eight miles of its length. The total number of deep-level tubes is eight and the capital invested is now $150,000,000. The annual passenger accommodation is 600,000,000. The average depth of the stations is 60 feet. That at Finsbury Park is only 20 feet, while those at Covent Garden and Hampstead are 123 and 185 feet respectively.—Railway and Engineering Review.

The Winner of the Hower Trophy for Automobile Runabouts.

After a successful three days' journey from New York to Buffalo, the 30-horse-power White steam runabout was finally declared the winner of the Hower trophy. The 35-horse-power Stoddard-Dayton gasoline runabout, which was tied with the White steamer when the competition for the Glidden trophy terminated in New York, after making two successful runs from New York to Albany and Albany to Syracuse, finally broke a spring during the trip to Buffalo and arrived 35 minutes late. On account of the consequent penalization of the gasoline machine, the steam machine was declared the winner. The cars covered a total distance of over 2,000 miles on some of the worst roads in the country, and it is worthy of notice that these two machines were the only runabouts in a company of thirteen that started, to finish the 1,570-mile tour with a perfect score and then to continue 400 miles further. These extra 400 miles were covered at a speed of about 18 miles an hour.

Of the cars which contested for the Glidden trophy, one, a 16-horse-power Reo, immediately after the termination of the tour, made a 330-mile trip in 25½ hours elapsed time, from New York city to Cape Charles, whence it was ferried to the Jamestown Exposition. The average speed in this case, including all stops, was about 13 miles an hour. This shows the car was still in good condition after its long and strenuous journey in the Glidden tour.

The Wright's Aeroplane to be Tested in France.

As already noted in a previous issue, the Wright brothers have been in Europe with the idea of selling their aeroplane to one of the European governments. According to a recent cable dispatch, they have made an arrangement with Senator Henri Deutsch de la Meurthe and the French government, as a result of which they will soon make a demonstration for some officers of the military balloon corps and two engineers appointed by M. Deutsch. Their aeroplane is said to have been shipped to France from their home in Dayton, Ohio, about the middle of last month.

Butter or Cheese Color.—I. Nine parts of annatto (Orlean) extract and 1 part of saffron are digested with 100 parts of fresh olive oil for two hours in the water bath, and after settling for eight days, filtered.

II. Etheric Orlean extract 10 parts, fresh salad oil 500 parts. Over the Orlean extract in a bottle fresh salad oil is poured and finally dissolved by shaking or by heat, the bottle being frequently dipped into hot water.

Correspondence.

Mortar Batteries on War Vessels.

To the Editor of the SCIENTIFIC AMERICAN:

I was much interested in the article on battleship construction in last week's SUPPLEMENT. The idea occurred to me that if a special ship could be constructed to carry 11-inch mortars, it would revolutionize warfare on the sea as much as Ericsson's "Monitor." I think that the East and West are bound to try conclusions at some future time as surely as Greece and Persia in ancient times. Force still rules the world, and will rule it for an indefinite time to come. I think the Yankee has got to hustle to keep ahead of Japan in naval science.

Spencer, Mass., July 20, 1907. EVERETT H. MORSE.

International Yacht Racing on the Pacific Coast.

To the Editor of the SCIENTIFIC AMERICAN:

Your article on page 526, "American Yachting Season of 1907," might well have been completed and the subject rounded up geographically by reference to the "Alexandra" cup race out here. A $2,000 cup given by Gov. James Dunsmuir of this province and named after Her Most Gracious Majesty our Queen, was competed for as an international trophy for the first time during the past week. The North Pacific Yachting Regatta being held this year at Seattle, the governor consented to take his trophy into foreign waters on the occasion of the first competition, an act somewhat without precedent on this continent, and strangely enough quite unnoticed and wholly unappreciated by the yachtsmen of Puget Sound.

Two yachts were entered—it is a 29-foot class event—"Spirit," a Herreshoff design, built and sailed by Geary of Seattle, and the "Alexandra," a Fyfe design, built by Watts of Vancouver to the order of the Royal Vancouver Yacht Club and sailed by W. E. Graveley, formerly of Toronto.

First race was on the 2d, "Spirit" winning by 5 seconds. Second race on the 5th, "Alexandra" winning by 3 seconds. Third race on the 6th, "Spirit" winning by 3 minutes.

This annual has been established through efforts of Vancouver Club, which is one of four in Canada having and entitled to the honor of adding "Royal" to its name, while its decked yachts have the privilege of flying the "blue ensign." J. H. MACGILL.

Vancouver, B. C., July 7, 1907.

Steering and Equilibrium-Preserving Devices for Aeroplanes.

To the Editor of the SCIENTIFIC AMERICAN:

In a specially prepared article which appears in a recent number of the SUPPLEMENT, Mr. R. H. Goddard describes an interesting device for steering and balancing aeroplanes.

He proposes that inventors make use of the gyroscope (a spinning top) which when revolving rapidly always tends to rotate in the same plane of action.

This mechanism is to be secured to the frame of the aeroplane in such a way that as the machine tilts in any direction, corresponding electrical contacts are closed by the swinging gyroscope, and certain automatic changes made in the arrangement of the wings or weights controlling the aeroplane.

This idea is quite clever, but unfortunately the particular type of mechanism brought forward by Goddard has certain defects which render its application to a motor-driven aeroplane practically impossible.

The principal drawback is met in designing the devices to act under the direction of the gyroscope in adjusting the wings or shifting the weights. In the first place, they must perform the changes very rapidly, and this necessitates the application of considerable power, independent of that used to propel the machine.

Second. The shifts must be made exactly to the extent required, and the slightest derangement of the mechanism (necessarily very delicate) renders the contrivance worse than unmanageable.

Third. It would be quite impossible to install a device depending for its efficiency on the movements of balanced parts on a machine propelled by a reciprocating engine, as the least vibration of the framework, if transferred to the controller, would render the arrangement quite ineffective.

It might be inferred from the foregoing that the application of the gyroscopic principle to the controlling of aerostats is impossible, but I do not believe this to be the case.

It must be remembered that this device has been used with notable success on submarine vessels, which require to be steered and balanced in much the same way as do ships of the air.

However, the fluctuations of air currents as compared to the steadiness of water must be considered as an important factor by the inventor who proposes to install a gyroscope of the type used in torpedoes on an aeroplane, and it is quite possible that some new vagary of the wind may be brought out by this device, that will defeat our entire purpose.

The gyroscopic principle may be applied to the balancing of objects in positions of unstable equilibrium, by one of two systems:

First. By the use of a small gyroscope of inconsiderable weight, directing the movements of larger and more powerful mechanism.

Second. By means of two or more wheels of considerable weight (gyroscope 1/20 weight of whole machine) which may be revolved directly at high speed by the motor used for forward propulsion.

The latter type of apparatus has proved efficient, and has no delicate parts to get out of order and break when the aeroplane comes to earth. If properly balanced, such an aeroplane also tends to decrease the vibration and racking of the framework caused by the motor.

A gyroscope powerful enough to control in one plane of action an aeroplane of about 300 square feet of supporting surface may be made from an ordinary bicycle wheel weighted at its circumference with a metal rim. This should be revolved at a speed of about 500 R.P.M., and if a metal case can be provided that will enable the wheel to revolve in a vacuum, its efficiency will be greatly increased. L. J. LESH.

Montreal, Quebec, July 26, 1907.

A Reply from Prof. Michaud.

To the Editor of the SCIENTIFIC AMERICAN:

In a letter published in the June 15 issue of the SCIENTIFIC AMERICAN, Mr. D. E. Keen objects to the theory which attributes to the nervous element of the eye the setting upright of the inverted retinian images. According to Mr. Keen, the cause of the phenomenon is purely mechanical, and lies in the fact that "the different portions of the retina merely see the object in the direction from whence they receive the light." The following diagram, which shows the path of the luminous rays in the case of ordinary vision (distance from object to eye being shortened to spare space), will help the reader to understand Mr. Keen's theory:

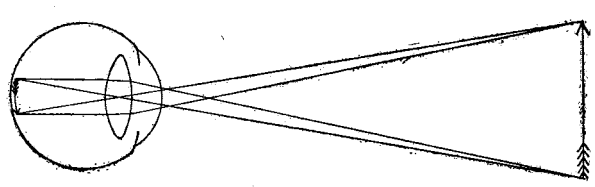


Fig. 1.

Although the image of the arrow, on the retina, is inverted, according to Mr. Keen, we see it right side up because most of the rays which emanate from the upper part of the arrow strike the retina just as if they came directly from a point situated above, while the rays which come from the inferior part of the arrow have such a direction as to cause us to believe that they come directly from below.

This theory might prove acceptable if it were not that one fact, at least, contradicts it, and that fact is precisely the experiment, "A Curious Illusion," published in the May 25 issue of the SCIENTIFIC AMERICAN. The accompanying figure illustrates the path of the rays when the card with three holes, two of which are in the plane of the drawing, is kept close to the eye, while the card with one hole is placed at a few inches from the other.

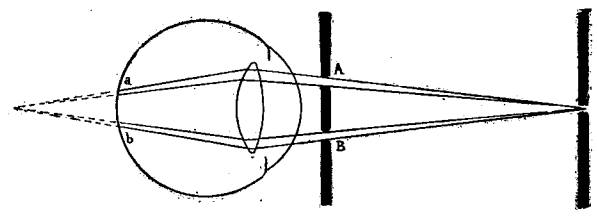


Fig. 2.

A glance at the diagram shows that the luminous pencil which has passed through the upper hole *A* strikes the retina in *a* as if it came from a point situated higher than the portion of the retina which it reaches. The contrary is true for the pencil which strikes the retina in *b* after passing through the lower hole *B*. According to Mr. Keen's hypothesis, the retina should perceive the holes *A* and *B* in the direction of the rays which emanate from them. The hole *A* should appear as it stands on the card, as its image stands on the retina, that is, above the hole *B*. No inversion should take place. An inversion does take place, and that inversion cannot be explained, as in the case of ordinary vision, by the supposition that the different portions of the retina merely see the object in the direction from whence they receive the light. The hole *A* is seen in the direction of the rays which emanate from the hole *B*, and *B* is seen in the direction of the rays sent by *A*.

GUSTAVE MICHAUD.

Costa Rica State College, June 29, 1907.

A New Way of Printing Books.

To the Editor of the SCIENTIFIC AMERICAN:

If any one will take up a magazine or kindred publication of the ordinary binding, or even one of the many books which are daily read by millions, and note the position of the printed matter, he will recognize that owing to the shape of the opened page at scarcely any time are the characters on the line before him at equal distances from both his eyes; and that these distances, as he reads across the page, are constantly varying, owing to the convex or curved form which the page assumes when it is opened for reading. This is more pronounced in magazines, though the line on the open page of most books is far from level.

This necessitates that the focus of one eye be continually altered from that of the other for every word read on the line according to whether it is nearer to or farther from that eye of the reader than it is from the other. Is not this a great ordeal for the very delicate and mutually sympathetic system of nerves and muscles that regulate the focusing of the eyes?

Would it not be a great boon to the millions of daily readers to have the pages of the thousands of bound periodicals so printed that the focus of the eyes in reading would be mutually the same? This could in a great measure be accomplished by printing the lines parallel instead of transverse to the binding, that is, have the print read from the bottom to the top of the present page instead of across, so that when the work was opened each line would be level from end to end and could be held so that the two eyes might have the same focus at the same time and not be obliged to make continual and trying changes such as are requisite with the present method?

This would make reading, from the fact that it would be easier for the eyes, more profitable and enjoyable to the reading public the world over; and might it not in the course of a few generations greatly reduce that large number who suffer from certain forms of ocular defects due to the eyes being mutually out of adjustment? W. F. RONALD.

Daytona Beach, Fla., July 1, 1907.

Official Meteorological Summary, New York, N. Y. July, 1907.

Atmospheric pressure: Highest, 30.18; lowest, 29.59; mean, 29.88. Temperature: Highest, 89; date, 8th; lowest, 61; date, 5th; mean of warmest day, 82; date, 18th; coolest day, 68; date, 29th; mean of maximum for the month, 82.5; mean of minimum, 67.1; absolute mean, 74.8; normal, 74; excess compared with mean of 37 years, + 0.8. Warmest mean temperature of July, 78, in 1901. Coldest mean, 70, in 1884. Absolute maximum and minimum of this month for 37 years, 99 and 50. Average daily deficiency since January 1, —1.5. Precipitation: 1.18; greatest in 24 hours, 0.55; date, 20th; average of this month for 37 years, 4.38. Deficiency, — 3.20. Accumulated deficiency since January 1, —3.74. Greatest precipitation, 9.63, in 1889; least, 1.18, in 1907. Wind: Prevailing direction, south; total movement, 6,847 miles; average hourly velocity, 9.2; maximum velocity, 45 miles per hour. Weather: Clear days, 8; partly cloudy, 16; cloudy, 7; on which .01 inch or more of precipitation occurred, 7. Thunderstorms, 2d, 7th, 8th, 11th, 12th, 18th, 20th.

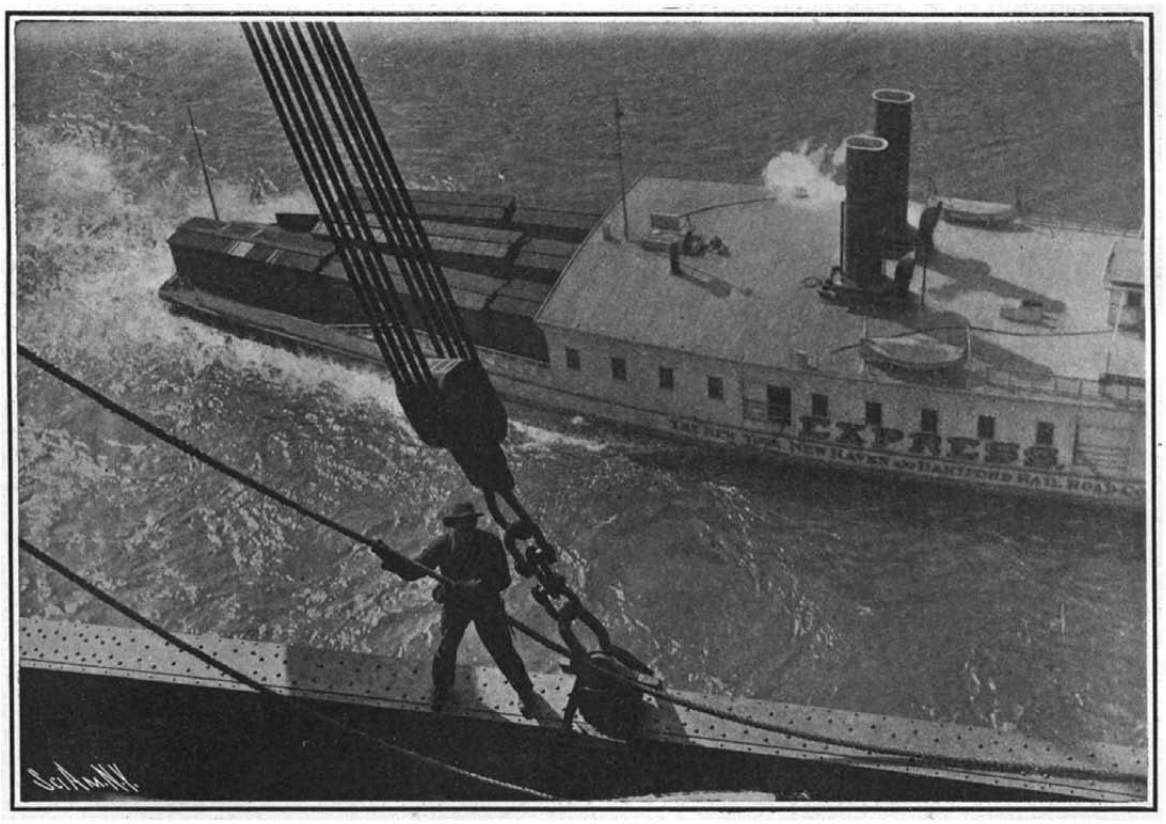
The Current Supplement.

An explanation of the action of the gyroscope in every-day language, and free from mathematics, is something to be desired. With this idea, C. M. Broomall contributes an article to the current SUPPLEMENT, No. 1649, which will enlighten those of our readers who are unable to comprehend the highly complicated mathematics which underlie this ingenious piece of apparatus. Mr. Randolph Bolling describes how silver is reclaimed from photographic solutions. Some of the technical and commercial aspects of wireless telegraphy are presented by Mr. William Weaver, Jr. The zoological park which Mr. Carl Hagenbeck has been erecting at Stellingen, a suburb of Hamburg, is now completed. It was formally opened a short time ago in the presence of a distinguished gathering of zoological experts. Mr. Harold J. Shepstone describes this wonderful park most interestingly. Excellent pictures accompany his text. D. Sidersky writes on the industrial uses of caseine, a subject of considerable importance when it is considered to what a great extent the adhesive properties of caseine are utilized. Caseine is used in the paper industry, in woodworking, in glue making, in painting, as a textile mordant, as a plastic material, and as a clarifier of wines. Major B. F. S. Baden-Powell contributes a most instructive article on aeroplane laws. The physiological functions of the nectary and the sources of honey are authoritatively treated by Gaston Bonnier, who is probably the foremost authority on the bee in the world. Our Berlin correspondent records the astonishing achievements of Dr. Rueckle, an arithmetician of wonderful ability. Prof. F. H. Oliver writes on The Seed; a Chapter in Evolution. Mr. J. H. Morrison examines the origin of the St. Swithin's Day legend.

THE ERECTION OF THE BLACKWELL'S ISLAND BRIDGE.

As will be seen from our illustrations, the erection of the Blackwell's Island cantilever bridge across the East River, at 59th Street, has progressed to a point at which its majestic proportions and undeniable symmetry show up to good advantage. Particularly impressive is the view obtained, say, from the deck of one of the Sound steamers, when one is passing through the channel to the west of Blackwell's Island, or from the river front on Manhattan Island at the foot of 57th Street, the point from which the accompanying fine view of the structure was taken.

New York city is the home of majestic bridges. Two of the three giant bridges of the world (the third is the Forth Bridge in Scotland) are located in this city, namely, the old Brooklyn Suspension Bridge and the later Williamsburg Suspension Bridge. Both of these structures are of the suspension type, and because of the aspect of lightness and delicacy which they carry, due to the great strength of the wire and corresponding small dimensions of the suspension members, they fail to convey the appearance of strength and heavy mass which one naturally would expect in structures of this weight and magnitude.



One of the Bridge Gang Standing on a Floor Beam Which Has Just Been Swung Into Position.

Not so, however, with the great structure at Blackwell's Island, which is the first cantilever bridge built in this section of the country that is at all comparable with our two great suspension bridges in size, weight, and strength. Here the relatively close massing of the members of the trusses, and the great size of their sections, lend to this bridge an impressive grandeur which is more pronounced even than in the case of the two suspension bridges.

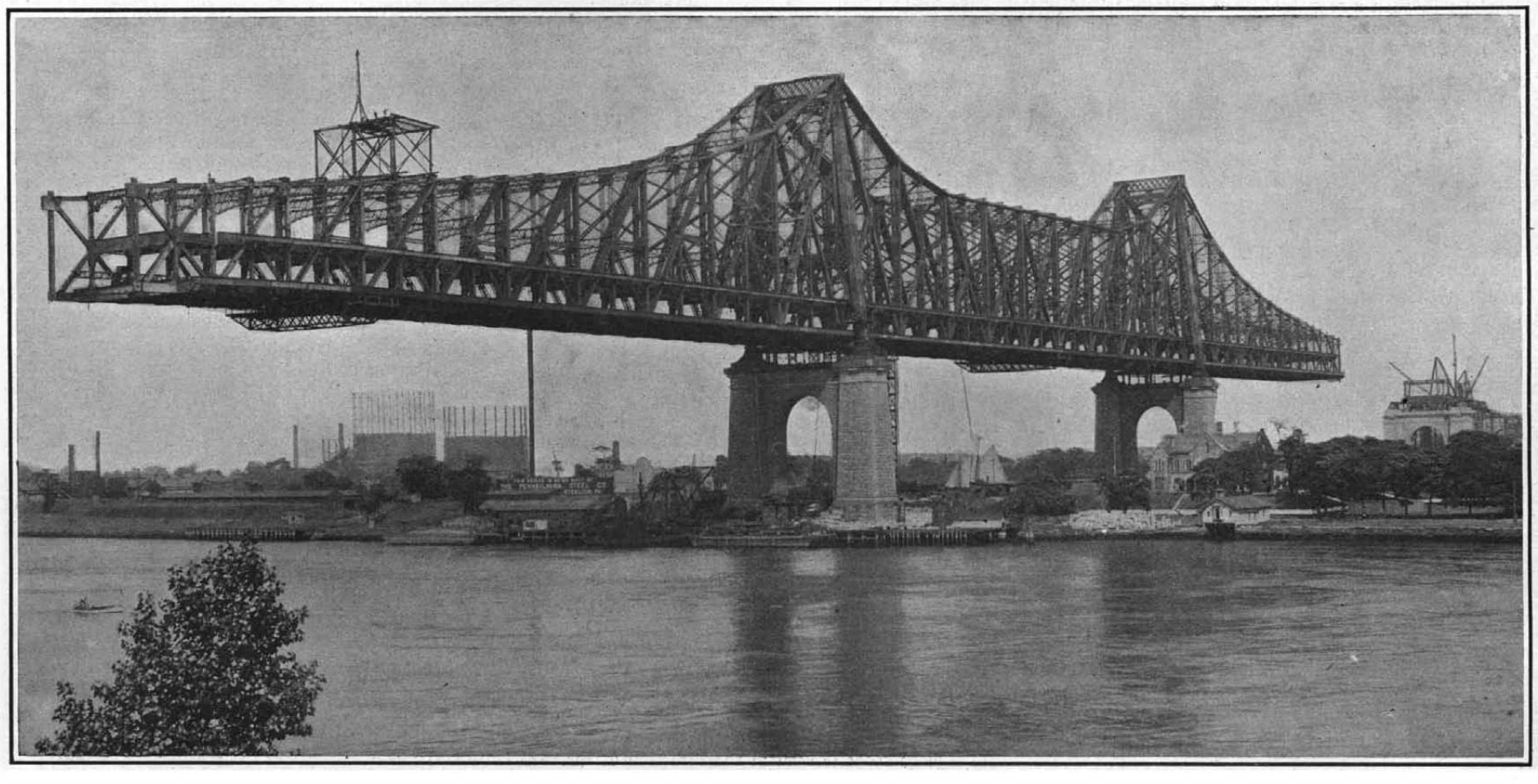
The whole structure is made up of five spans of varying length, with a long stretch of steel and masonry approach at each end. The Manhattan approach, built mostly of masonry, is 1,051 feet in length, and extends parallel with 59th Street to a pier on the westerly shore of the East River, where the truss bridge proper commences. Of this, there is first the shore arm 470 feet in length, of the westerly cantilever. Then follows the great 1,182-foot span, made up of two cantilever arms each 591 feet in length. Next follows the Island span, 630 feet between towers; then the span over the easterly channel of the East River, which measures 984 feet between towers, and consists of the two river arms of the two easterly cantilevers, each 492 feet in length. The last span is the shore arm of the easterly cantilever, which is 459 feet in length. The descent into Long Island is made over an approach 3,455 feet in length, which, for the most part, consists of steel bents and plate girders. From the above description, it will be understood that the bridge proper consists of four cantilevers carried upon the same number of towers. Provision for movement and changes of length due to temperature and loading is made at the center of the two channel spans, where the abutting ends of the cantilever arms are connected by a hinged rocker bent, the rocker being pin-connected to the bottom of one truss and to the top of the other. The total length of the cantilever structure is 3,725 feet, and the length of the whole bridge, including the approaches, is 8,231 feet.

The trusses are built partly of a special nickel steel and partly of the ordinary commercial structural steel, the structural steel being used, roughly speaking, for the compression members and floor system, and nickel steel for the eyebars or tension members. The use of nickel-steel eyebars is due to the initiative of the former Bridge Commissioner Gustav Lindenthal, from whose designs the present bridge, with slight modifications, has been built. In spite of the subsequent interested opposition against the use of nickel-steel eyebars, it was found that only by their employment could a satisfactory design be worked out for this bridge; and the present eyebars, as now being furnished by the manufacturers, are not only meeting the requirements of the specifications, but in the acceptance tests have invariably exceeded these requirements. In the structural steel, the specifications called for an elastic limit of 28,000 pounds, and an ultimate strength of 56,000 pounds, and the requirements for the nickel-steel eyebars are an elastic limit of 48,000 pounds and an ultimate strength of 85,000 pounds. From which it will be seen that the nickel-steel bars are from 40 per cent to 50 per cent stronger than ordinary structural bars of the same weight.

The steel superstructure of the bridge is carried upon masonry towers of unusually pleasing design and of most excellent masonry. Good foundations were found at every point, the rock lying only a few feet below the surface on Blackwell's Island, and at a depth of about fifty feet on Manhattan and Long Island. The piers are built of concrete below ground, and above ground of granite facing with limestone backing.

Because of the great weight of the superstructure, it was necessary for the contractors, the Pennsylvania Steel Company, to execute a large amount of preliminary work in order to facilitate the erection. The bridge, from anchor arm to anchor arm, weighs 52,000 tons. The 630-foot span across the Island alone weighs 10,400 tons, or 16½ tons to the linear foot, and this was the first portion of the superstructure to be erected. So great was the load to be carried, that the ordinary timber falsework was not deemed of sufficient strength, and a special steel falsework, consisting of latticed towers and plate girders, was built upon specially-prepared foundation. This falsework alone weighed about 1,700 tons, and this is the first time that steel has been employed for this purpose, at least on such a scale. After the Island span was completed, the projecting arms of the cantilevers were built out from each end until they extended partly across the adjoining channels. This work has recently been completed, and is now in the condition shown in one of our engravings.

The handling of the material, lifting it from barges below, or from the storage yard, and lowering it into



The Completed Blackwell's Island Section of the New Cantilever Bridge Over the East River. Length from End to End, 1,713 Feet.

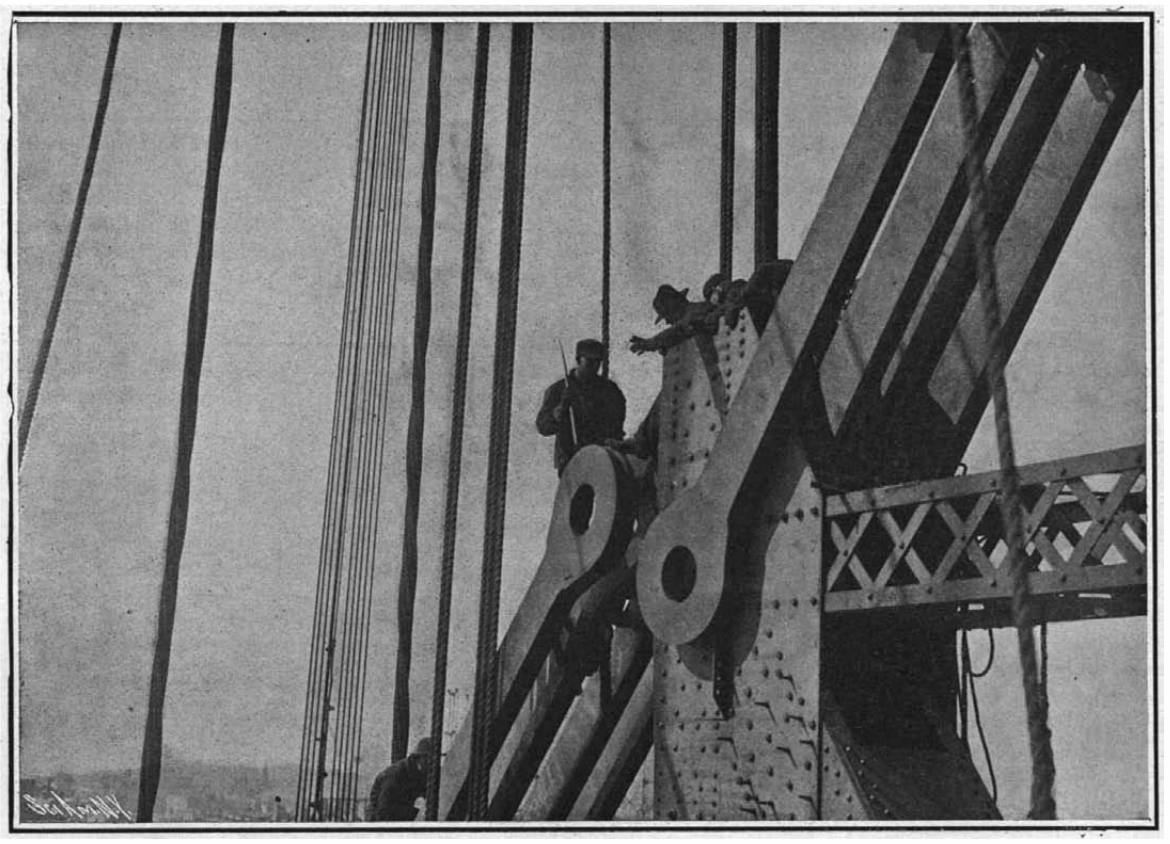
Cantilever arm in foreground, 591 feet. Central span, 630 feet. Cantilever arm in background, 492 feet.

ERECTING THE GREAT CANTILEVER BRIDGE ACROSS THE EAST RIVER AT BLACKWELL'S ISLAND.

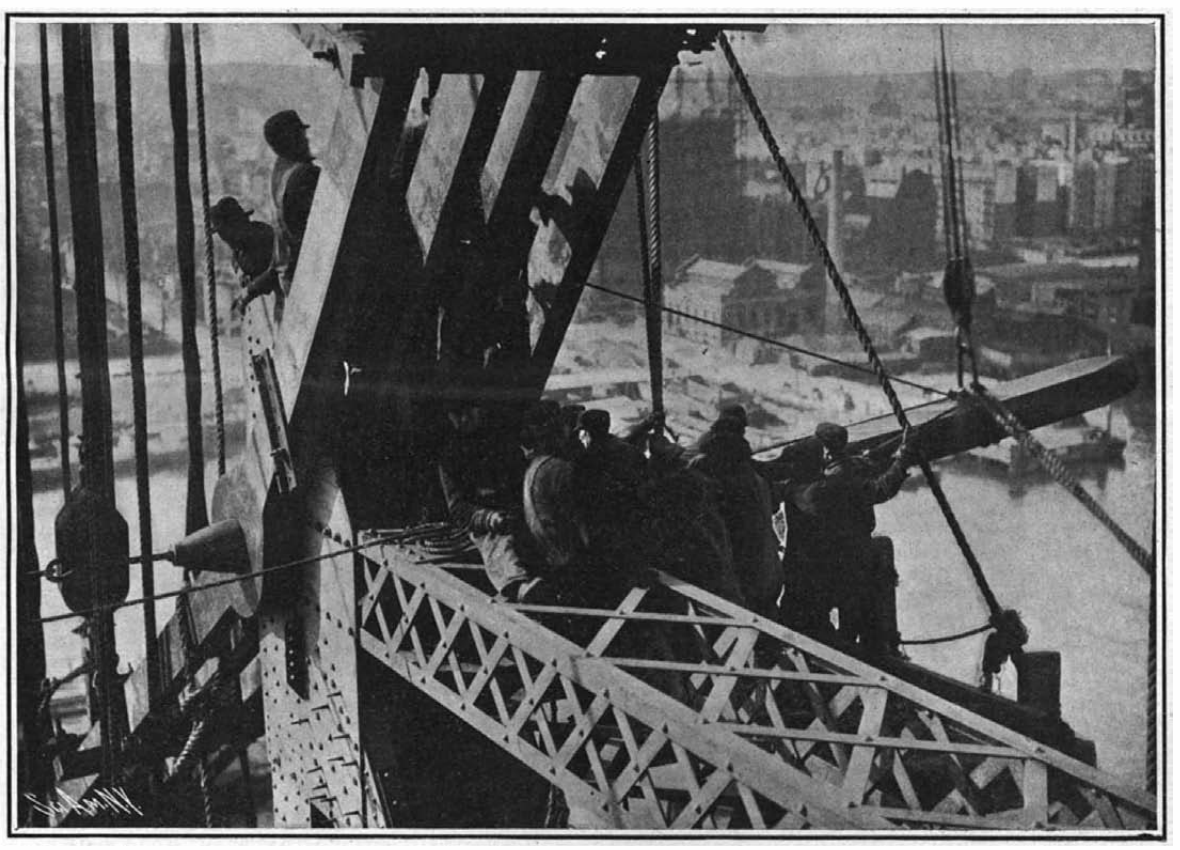
place ready to be coupled up at the end of the projecting trusswork, was accomplished by special derricks and by a large "traveler," 120 feet in height, which moved out over the projecting cantilever as it advanced. The traveler is built in the form of the letter Z, the upper arm projecting over the work, and the lower arm reaching far back into the span, where it is counterweighted or bolted down to the completed cantilever. This traveler itself is a huge and costly affair, weighing 500 tons and capable of handling a load of 70 tons.

Several of our engravings show the bridge erectors at work, guiding the heavy bridge members into position and connecting them by large pins at the various panel points. Two of the most interesting views are those showing the assembling of the ends of the eyebars, and centering them at their point of intersection with the plates of one of the vertical posts. As soon as everything is in true line, the steel pin, which, in the case shown, was 14 inches in diameter by 5 feet long, is driven into position by means of a five-ton swinging ram, the blows of which are directed against the head of the pin in the way shown in our illustration. To guide the pin through the eyebars and posts, it is furnished at the front end with a false conical head, temporarily screwed upon the pin. After the pin is driven home, the head is removed, and the large nut which serves to keep the pin permanently in position is screwed into place.

The completed bridge will have a very large capacity for traffic. This will be carried upon two floors, one above the other. On the lower floor, between the trusses which are spaced 60 feet center to center—



Assembling Eye-Bars at Intersection of Vertical Post and Diagonals, Ready for Pinning.



Driving Home a 14-Inch by 5-Foot Steel Pin at Intersection.

the overall width of the bridge being 88 feet—there will be a roadway 56 feet wide, the central portion of which, 36 feet in width, will be devoted to street and general vehicular traffic, the other 10 feet on either side being given up to two trolley tracks. On the outside of the trusses on the same floor, there will be two more trolley tracks, carried upon cantilever extensions of the floor beams.

On the upper floor, provision is made for the immediate construction of two elevated tracks, and for the future construction of two more elevated tracks whenever they may be needed—all four tracks to be carried between the trusses. On the outside of the trusses will be two 13-foot foot-walks carried upon cantilever extensions of the floor beams. It is estimated that the whole bridge will be completed by July 1, 1908.

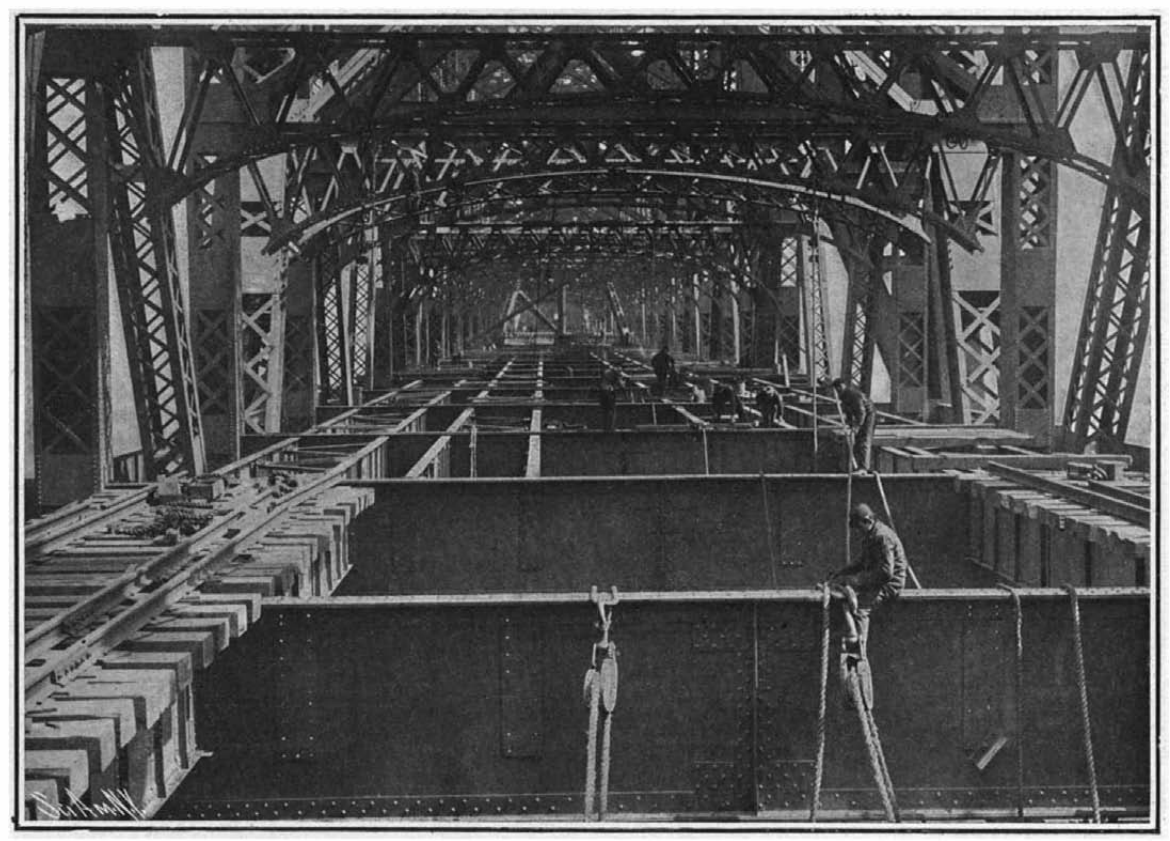
Mare Island Operator Performs Feat of Wireless Telegraphy.

Early during the present year the wireless telegraph operator at Fort Rosecrans, San Diego, established a record for receiving and transmitting long distance messages by intercepting a message sent from Washington, D. C., to a vessel on the Pacific Ocean. A remarkable feat of wireless telegraphy has recently been accomplished at the Mare Island station in California. On the morning of June 18 R. R. Murphy, wireless telegraph operator at the navy yard, while adjusting the instruments, intercepted a message from the steamer "President," then off the coast of Nome, Alaska, to the government station at North Head, Wash. Though Nome City is more than two thousand miles distant from Mare Island, Murphy caught the message, "We are off the coast of Nome. How do you hear us?" The Mare Island station is the principal one on the Pacific Coast and has accomplished a great deal of good long-distance work. The longest distance over which messages have been transmitted or received at the Mare Island station was 1,054 miles, but Murphy's work has quite eclipsed this. The admiral in command of the Mare Island navy yard has commended Murphy highly and will send a report of his achievement to the Navy Department at Washington, D. C.

One of the most interesting and novel gushing wells in the world, and perhaps without a rival in either respect, is a geyser of soda water that recently came up at Wendling, just across the Mendocino County border from Sonoma, Cal.

This well produces soda water—genuine soda water—and of a quality that would warrant bottling for the general trade, in such quantities as were never struck before. There is so much of this water that it is turned into a huge long flume, and used to float great logs from the forest to the lumber mills.

An artesian well borer was recently employed to secure an adequate water supply for a large sawmill in that region. He drilled to a depth of 200 feet, the lower 110 feet being through solid granite. Then a slight trace of water was found. The artesian-man then placed fifty-four sticks of dynamite at the bottom of the well, and exploded them. Instantly water gushed up, rising 20 feet above the surface of the ground, pouring forth in enormous volume. That was days ago, and since then there has been no indication of a cessation of this vast "natural soda fountain."



View Looking Along Upper Floor of Bridge; Shows the Main Trusses, Lateral Bracing, and Floor Beams.

ERECTING THE GREAT CANTILEVER BRIDGE ACROSS THE EAST RIVER AT BLACKWELL'S ISLAND.

A REVOLUTION IN POSTAL CAR CONSTRUCTION.

BY LOUIS C. KANE.

New methods are being adopted by railroad companies in the construction of postal cars, with a view to reducing fatalities in accidents on the line and to afford as great resisting power as possible in collisions. Worthy of note in this connection is the new all-steel mail car, known as car No. 6546, operated by the Pennsylvania Railroad Company between New York and Washington, which recently had its initial run and was inspected and approved by the Postmaster-General and other officials of the Post Office Department.

Previous to the building of this car, the strongest and best-equipped car was that known as the "Universal Postal Car," which is 60 feet long, constructed of wood, lighted by gas lamps, and weighs 110,000 pounds. The new mail car is the nearest approach to the ideal all-steel car that has yet been built; it contains only 370 pounds of wood, but has 2,840 pounds of fireproof composite and asbestos board, and 3,200 pounds of cement flooring. Everything in the car, including paper cases, letter cases, paper boxes, and doors, is metal. It is ten feet longer than postal cars built heretofore, and is the first 70-foot postal car ever built. An entirely new interior arrangement has been effected, which includes space at each end of the car, and this eliminates the necessity for turning the car end for end at terminals.

The maximum outside dimensions are: 74 feet 9¾ inches length over buffers; 9 feet 11½ inches width over roof eaves; and 14 feet 5 inches height from top of rail to top of junction box on the roof. The inside length is 70 feet 8¾ inches, and inside width 9 feet ⅜ inch. The wooden postal cars have reinforced ends containing 10-inch beams placed vertically at each side of the doorways, while the 70-foot steel car has 12-inch I beams. The new car is lighted by electric lamps in conjunction with storage batteries and an axle-light generator, and weighs 128,500 pounds. The trucks and body framing incorporate all the features which were introduced in the steel passenger car. The trucks are of the six-wheel type, have a framing made of steel entirely, and are of sufficient strength for use under cars having a total weight of 190,000 pounds. The axles are of large diameter, and the wheels are made of rolled steel. A special flexible spring rigging combined with the use of four side bearings per truck imparts exceptionally easy riding qualities.

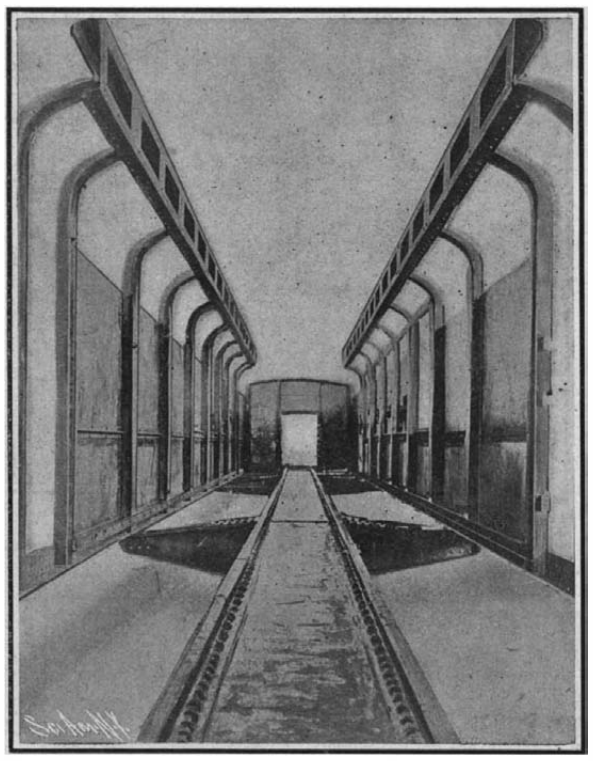
The body framing of the car includes a heavy central box girder built up of two 18-inch I beams and two ½-inch by 24-inch cover plates, and side girders 36 inches deep, having a strong bottom flange made of an angle, and a top flange of large area, which also forms the belt rail. A 12-inch I beam is placed on each side of each end door, riveted at the bottom to a steel center sill and casting, and at the top to a cross beam of channel section. The cross beam distributes the strains, which may come on the vertical I beams on account of collision, to the roof construction and side plates. This strong end framing, combined with the peculiarly heavy longitudinal girders in the underframe, presents end shock-resisting qualities never before attempted.

An entirely new departure from the old construction is the flooring, which consists of cement spread over corrugated iron foundation plates in a plastic state. The outside sheathing, including the roof, is made of steel plates. The inside of the car, where not covered with furniture peculiar to postal cars, is lined with fireproof composite board; and for sound and heat non-conductors, all inside lining plates are covered with an asbestos cloth glued to the sheets. The wires and storage battery boxes for electric lighting have been carefully insulated.

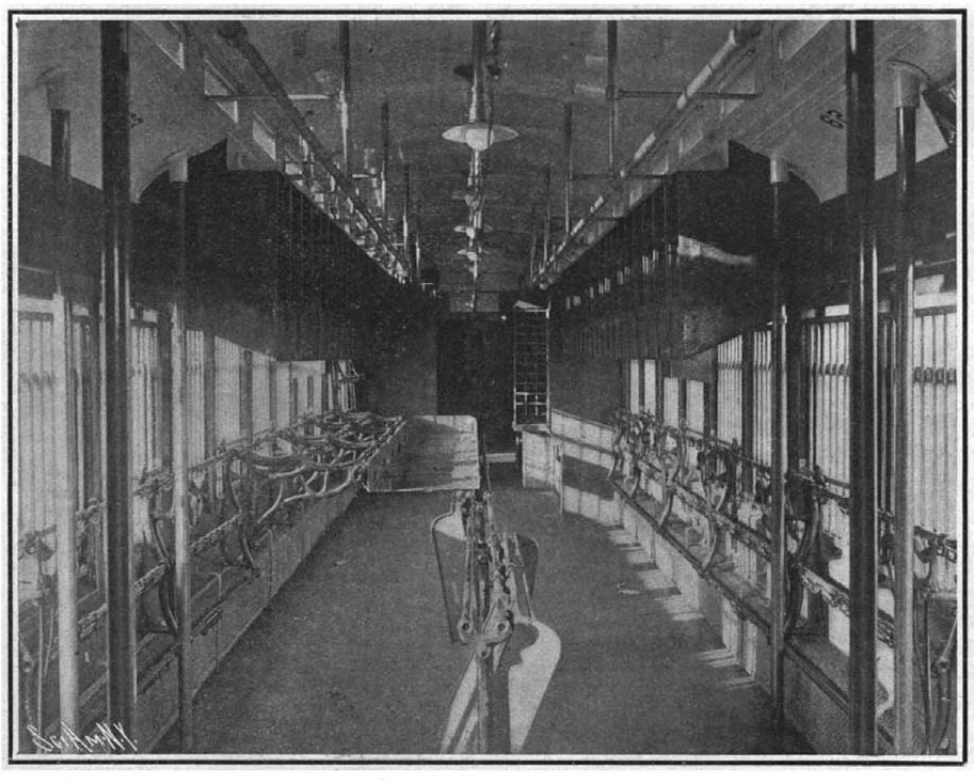
The steam heat and brake arrangements are of the latest and most improved types, and the draft gear is of the same flexible and strong pattern as that used on the steel passenger car. The furniture in the car is in conformity with the requirements of the Railway Mail Service Department, but it is made of steel instead of wood. The only danger from fire will be on account of the inflammable nature of the mails. Fire extinguishers are provided for emergency.

Heretofore the trouble with mail cars in accidents of a serious nature has been their inability to resist the impact as well as their destruction by fire. All chances of fire are eliminated, and the terrific force of a collision which the car has to sustain, due to its close proximity to the tender, is provided against by the reinforced ends of the car and the solidity of its cement floor construction. Whatever weight the car may have to sustain by rear coaches piling upon it, has been carefully worked out and provided for.

The car presents a fine appearance both inside and out, and the officials of the Post Office Department are well pleased with its construction. Aside from the fact that all fear of being reduced to ashes in a head-on collision is removed from a postal employee's mind during the performance of his duties, his life in the all-steel mail car is made an agreeable one by the new arrangement of the distributing cabinets, and by the easy-riding qualities of the car.



THE BODY FRAMING OF THE CAR.



INTERIOR OF THE STEEL POSTAL CAR.

A Safety Rescue Appliance for Submarine Boat Crews.

An ingenious invention, the object of which is to enable the crew of a submarine boat in the event of disaster to effect their escape, has been devised conjointly by Commander S. S. Hall, the British inspecting officer of submarines, and Staff Surgeon Oswald Rees, of H. M. S. "Mercury." The results of the investigations that have been carried out upon wrecked submarine craft after salvage have shown that in order to succor the crew within at the time of an accident, they must not only be saved from drowning purely and simply, but from asphyxiation from the noxious fumes of the chlorine gas, which is generated immediately the salt water comes into contact with the electrical storage batteries. Moreover, when a catastrophe befalls the vessel when submerged, facilities should be provided for the purpose of enabling the crew to escape from the craft and immediately ascend to the surface. It is a well-known fact that a diver, when in difficulties with his air supply while under water, immediately rises to the surface if he removes his weighted leaden boots and permits his dress to become inflated with air. The foregoing safety appliance is based upon this circumstance. There is a helmet made of light metal, so as to reduce the weight, and similar in design to that worn by divers, together with a canvas jacket. This helmet weighs only 10 pounds, and is so designed that it can be instantaneously donned by a man. Within this helmet is carried a supply of oxygen in concentrated form, which not only gives off ample supplies for breathing purposes, but also absorbs the exhaled carbonic gas, which it regenerates for reinhalation.

The success of this invention depends to a very great extent upon the concentrated oxygen supply, which is known as "oxylith," and which has been described at length in these columns. The evolution of this emergency substance is the result of several years' research, which were occasioned by the urgency for facilitating respiration in submarine boats when submerged, and dispensing with the necessity of periodical risings to the surface, in order to obtain a renewed charge of breathable atmosphere. "Oxylith" is oxygen purely in a latent state, retained in a compound, and all that is necessary when the gas is required, is to add water to the compound in precisely the same manner as acetylene gas is produced by the action of water upon calcium carbide. Immediately the water comes into contact with the compound, chemically pure oxygen is released, generation continuing until the water supply is cut off. The gas generation during the application of water is effected very violently, and the alkali residue acts as an excellent absorbent for the exhaled carbonic acid gas. The advantages of this concentrated oxygen-yielding compound are obvious, dispensing with the cumbersome steel reservoir cylinders, while it can also be kept for an indefinite period without deterioration so long as it is kept free from contact with moisture. The gas generated by this means consists of one hundred per cent pure oxygen, the yield per pound of the oxylith being three cubic feet. Even the residue is of value, since being soda lye it can be used for washing, bleaching, or other purposes.

With the safety lifebuoy helmet for use with submarines, a sufficient supply is carried therewith to sustain life for about eighty minutes, and this is ample time in which to permit the crew to effect their escape from within a wrecked craft. Immediately the man issues from the boat, the gas contained within his helmet and canvas jacket imparts such buoyancy to his body that he instantly rises to the surface of the water, where he will float safely until he can be picked up. In connection with this apparatus the inventors have devised special arrangements, by means of which the hatch of the conning tower can be opened readily and easily from within under all conditions. Another distinct advantage is that if necessary, such as in the case of dangerous operations, owing to the light weight of the appliance, it can be worn by the men while engaged in their duties within the boat, the helmet offering no inconvenience to their movements. The British government has tested the apparatus severely at Portsmouth, and owing to its complete success will, it is announced, officially adopt it for use in the navy.

Amundsen's Advice to Wellman.

Captain Amundsen, the well-known Arctic explorer, has expressed very pessimistic views as to the possibility of Mr. Walter Wellman reaching the Pole by means of his airship. He has strongly endeavored to persuade Mr. Wellman and his companions to postpone their expedition for at least a year when certain improvements which have proved their worth on French and German balloons might be added to their outfit.

The captain is confident that within a few years balloons will be constructed which will make the exploration of the pole possible; at present the risk is unduly great. Mr. Wellman's only hope, he thinks, lies in a strong south wind which might drift him across the Pole to some part of America or Asia. Should progress be delayed by adverse winds or other causes, the airship might be weighed down by crust ice; in which case a return by dog sleds would be necessary. Whether this return would be feasible would depend on where the airship sank to earth.

Mr. Wellman has, however, considered the risks. The record of Arctic exploration is one of contending with obstacles; no expedition yet started without knowing what it might be called on to face.

A Lens Composed of Multiple Liquid Floats.

BY HORATIO C. POLLOCK.

In the September 29, 1906, issue of the SCIENTIFIC AMERICAN an article, "Liquid Specula for Astronomical Purposes," appeared over the signature of A. W. Nightingale, of Hobart, Tasmania, and its appearance impelled me to make known some of the facts in regard to the discovery of a "parabolic mirror of incomparable precision, with practically no limit as to size," the discovery of Mr. C. H. Hulbert, wireless expert for the military government in Manila. The article in question was recently brought to my attention, and is the first intimation I have had that others in the Orient were trying by the use of liquid mirrors to improve the Newtonian telescope.

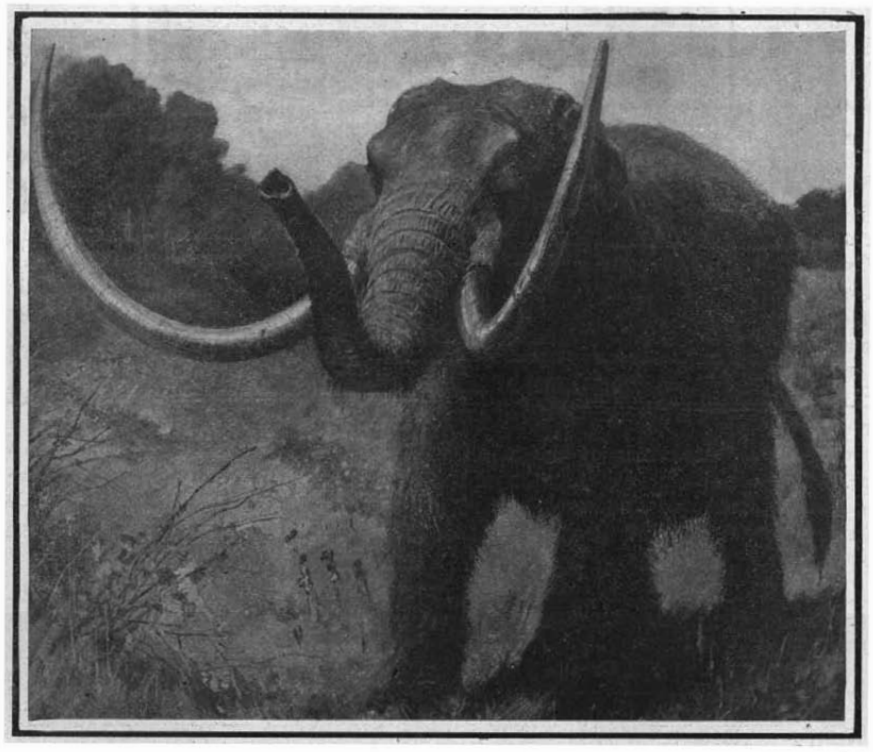
The use of a multiple, or as I shall term it, the Hulbert liquid float lens, has been directed, not only to test its worth in securing perfect optical performance, but also in studying the heavenly bodies, with results that, aside from the fact that the lens is a success, Mr. Hulbert will say nothing. Enough has been gathered, however, from demonstrations he has made in the presence of friends to convince them that the lens is all he claims for it.

The lens of the multiple floating disk telescope consists, in the major part, of a basin filled with oil (ordinary machine oil) or other liquid of some such consistency, in which revolve, balanced on magnetic center points, a combination of floats; the outer rotated by power transmitted by a finely-woven wire thread, the next inner revolved by frictional momentum; the lens basin, with a reflecting surface of mercury, in the center. The outer edge of the lens parabola is bent over to cut out capillary action on the side of the metal; the gears connected direct; the friction pulley controls the focus, resulting also in the total absence of vibration. A mirror is used, and a person can sit at the focusing point, and observe directly in the basin. This in a very limited way describes the lens. The public will have the benefit of all the facts concerning the invention as soon as the model reaches Drexel Institute, to which it is to be sent on the next steamer.

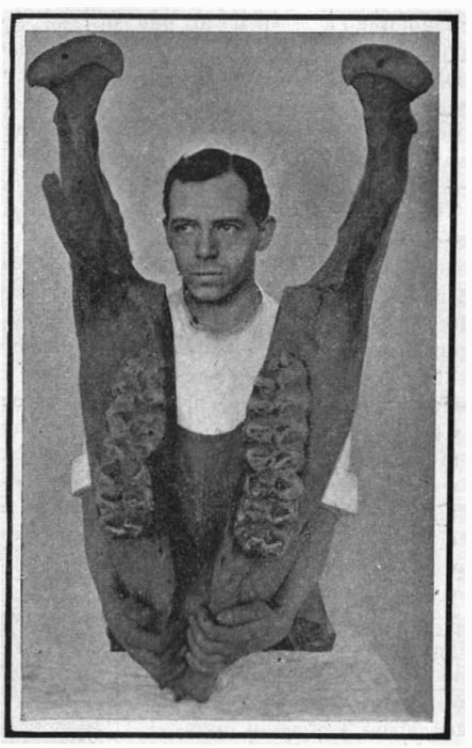
The International Motor Boat Race for the Harmsworth Trophy Won by an American Boat.

A cable dispatch announces that an American motor boat—Commodore E. J. Schroeder's "Dixie"—won on August 2 the handsome trophy given by Mr. Harmsworth for an annual international motor boat race. The "Dixie" beat her nearest competitor, "Daimler II.," by 1 minute 40 4-5 seconds in a 35-mile race run at Southampton, England. Her time was 1 hour, 15 minutes, 44 3-5 seconds, which corresponds to an average speed of 27.72 miles an hour. The "Dixie" is 39 feet 11 inches long and 5 feet beam. She is fitted with an 8-cylinder Simplex engine rated at 132.72 horse-power. It was expected that several of the fast French boats would compete, but they were ruled out on account of the entries not having been made in time.

A Tusk 8 Feet 7 Inches Long.



The Probable Life Appearance of a Mastodon.
Since the drawing was made it has been found that the tusks curved inward.
From a drawing by Charles R. Knight.



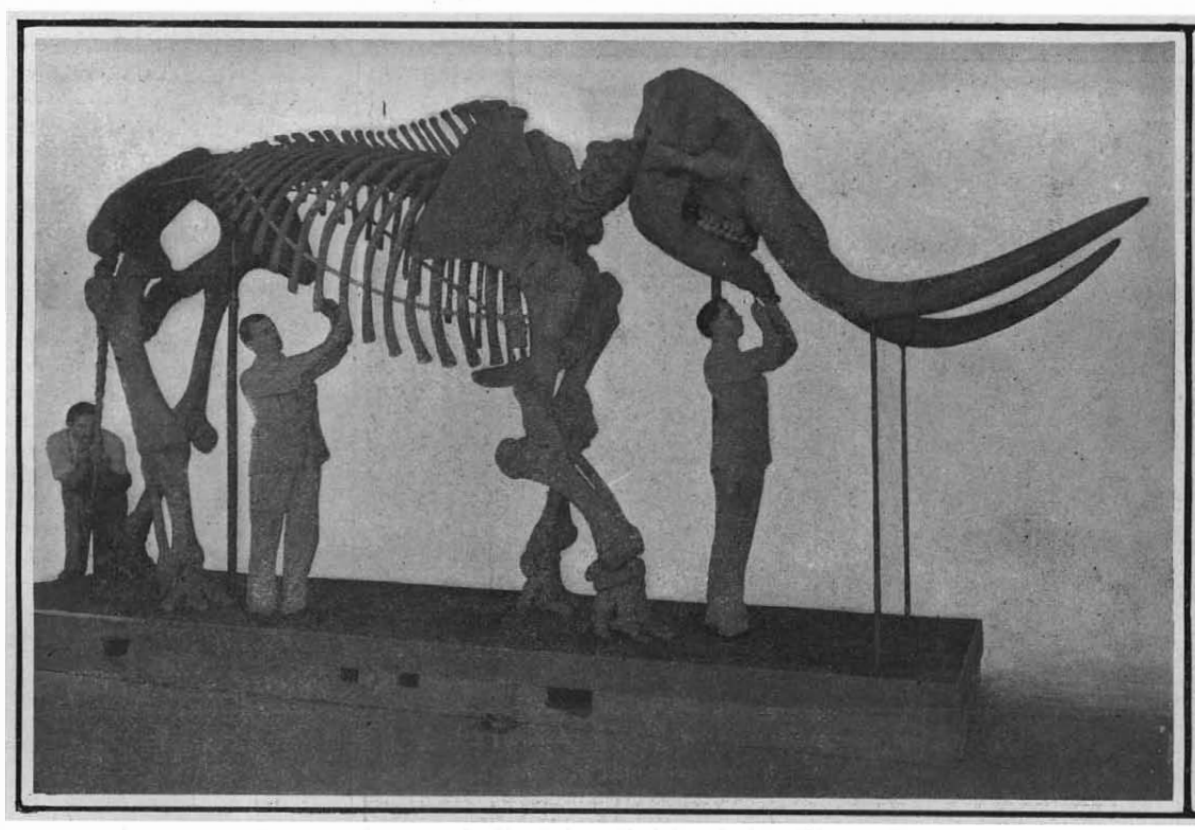
The Immense Lower Jaw of the Mastodon.

THE GREATEST OF MASTODONS.

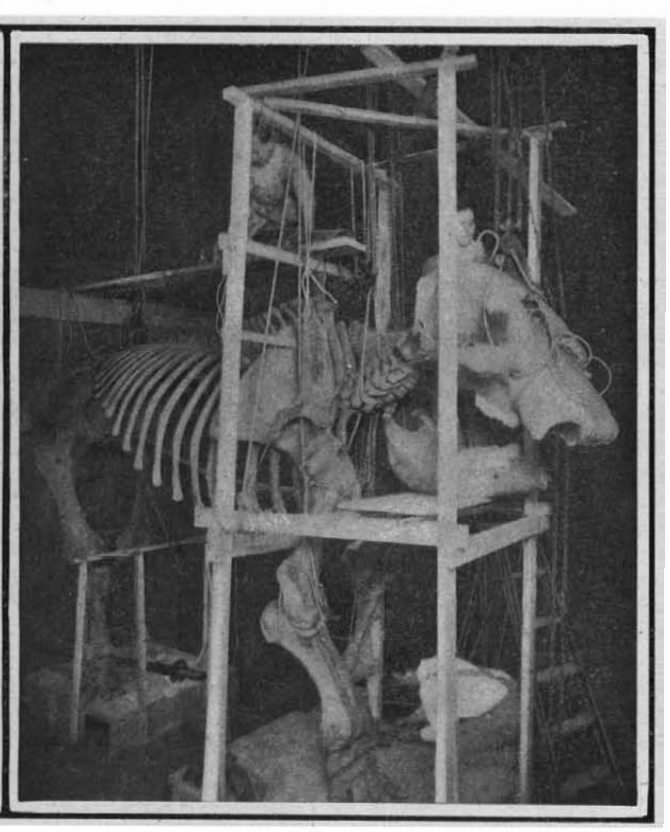
BY WALTER L. BEASLEY.

Through the generosity of J. Pierpont Morgan, Esq., the famous Warren mastodon skeleton, the most complete and finest specimen of its kind in the world, has been presented to the American Museum of Natural History. The splendid and accurate remounting and forthcoming exhibition of this rich fossil prize by Prof. Henry F. Osborn is considered one of the noteworthy achievements of this foremost paleontologist and a memorable contribution to science. The discovery of this celebrated fossil is not recent. After remaining fifty years in almost practical seclusion, more or less, and hidden away from the knowledge and inspection of the general public, now, thanks to the donor and the reconstructive technique of the paleontologist, the world at large is able to study and view this gigantic and record-breaking mastodon skeleton of America. The specimen was arranged so as to be on exhibition in time for the meeting of the International Congress of Zoologists, to be held in New York the middle of the present month.

Through the courtesy of Prof. Osborn the writer was given special facilities for obtaining the accompanying series of representative photos, together with some data concerning the discovery and other main details of interest connected with this remarkable specimen, for the pages of the SCIENTIFIC AMERICAN. The skeleton measures 14 feet 11 inches from base of tusk to tail, and 9 feet 2 inches in height. The original tusks were incorrectly reported as being over 11 feet, and so described and restored by Dr. Warren. But the correct original length has been very exactly determined by skillful piecing together of the fragments to be 8 feet 7 inches; of this 23 inches of each tusk is inserted in the sockets, and the projecting tusks measure 6 feet 8 inches. Only a portion of the base of tusks and a few of the toes of the fore feet are restored, the remainder being all genuine bone. An idea of the painstaking and laborious attention bestowed upon this specimen can be gleaned from the fact that an entire year was devoted in the Paleontological Laboratory to the preparation and correct adjustment of the skeleton. The skeleton was



The Finishing Touches. A Year's Work Has Been Devoted to the Preparation and Correct Adjustment of the Skeleton.



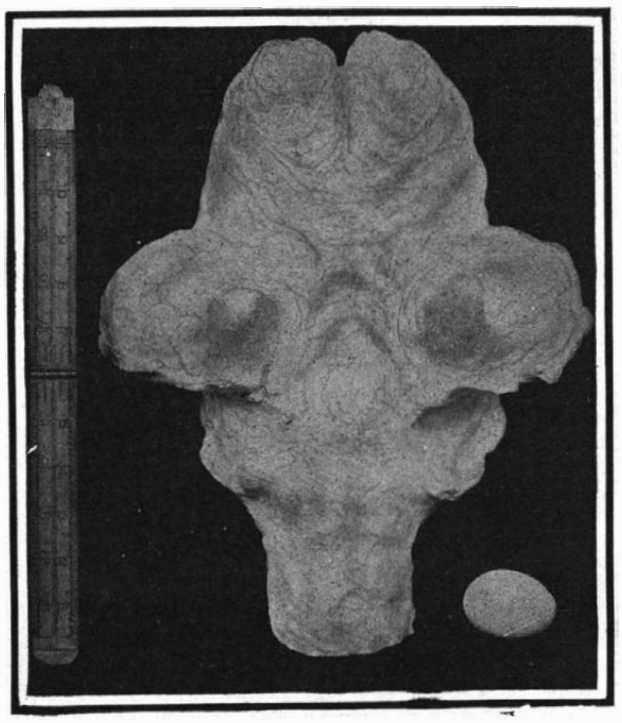
The Network of Scaffolding Necessary in Erecting the Skeleton.

THE GREATEST OF MASTODONS.

completely taken apart and all the bones given an alcoholic immersion, to remove the dark coating that had covered them, so that now they have the original bright red color, just as fresh and perfectly preserved as when first dug up.

The placing in position for experimental purposes to determine the proper poise, etc., of some of the enormous bones, such as the massive six-foot pelvis, fore and hind limbs, weighing from 100 to 500 pounds, was a delicate mechanical task, requiring a high, derrick-like structure, equipped with strong iron chains and pulleys for lifting and sustaining the weighty masses. A view of the mastodon encircled in this network of scaffolding is shown in one of the accompanying photographs. The mounting of the frame in a life-like, walking attitude was a difficult engineering task, which has been most skillfully accomplished by Mr. Adam Herman, chief preparator, and his assistants, Messrs. Lang and Schlosser, under the direction of Prof. Osborn.

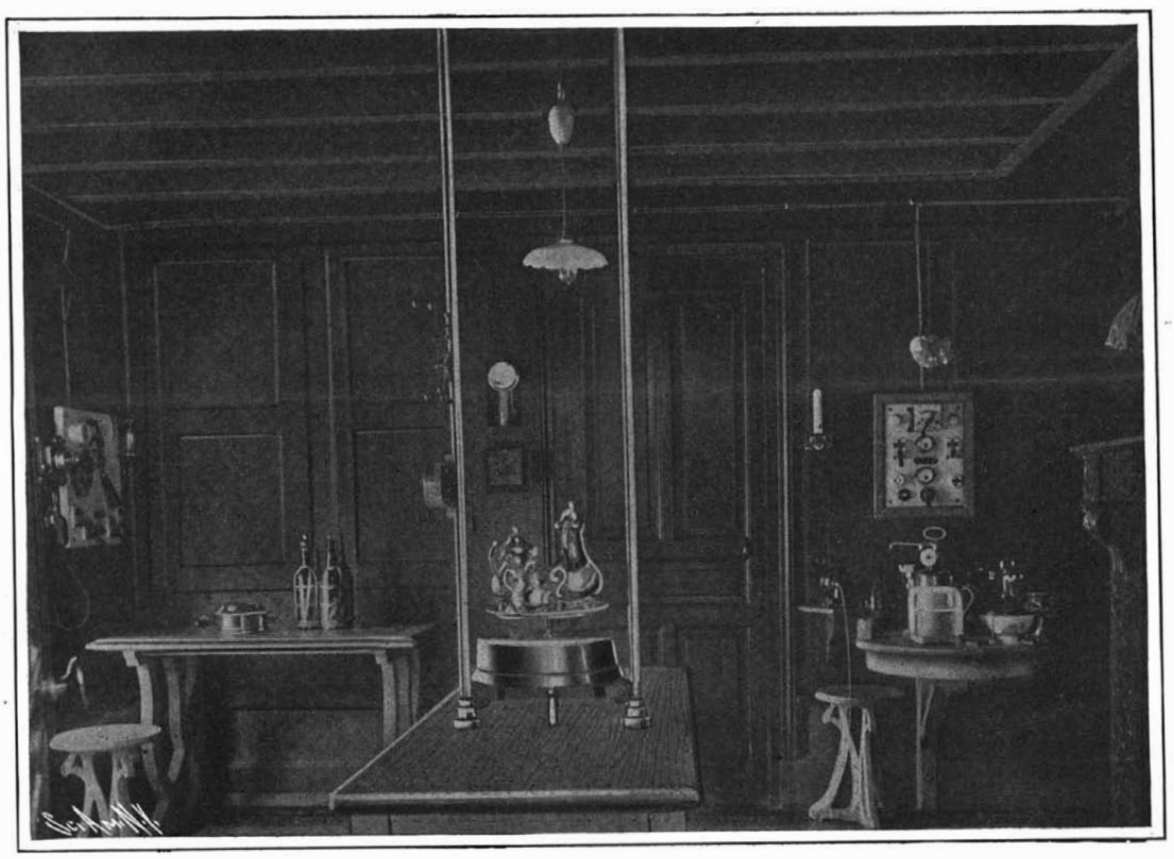
Here is a summary of the discovery near Newburg, N. Y.: Ulster and Orange Counties in this State, and the valley west of the Catskills and parallel with the Hudson, for some reason seem to have been a favorite haunt and habitation center of the mastodon. The physical conditions of this section of the country at this Post-Glacial Period, owing to the receding ice sheet, which had left numerous small pools affording a convenient source of water supply, and, moreover, an abundant feeding ground, were thought to have been especially favorable to their existence. This lucky and historic find was come upon by mere chance, in August, 1845, as follows: A Mr. Brewster, a farmer near Newburg, was desirous of obtaining some fertilizing material for his fields. In one of his bottom tracts there had been a small pool of water, about 40 feet in diameter, in the midst of wet, swampy surroundings. This spot, owing to an unusual summer drought, had been left dry, so the farmer determined to use its contents for his desired purpose. Consequently, he set a number of laborers to work with spade and shovel. After digging three or four feet the workmen came to a bed of shell-marl, and the spade struck a hard substance, which was thought at first to be a stone or log. On further excavating, however, it was discovered that it was a portion of a fossil remains, and the spade had first struck the top of the head. On the second day the buried object was excavated, and revealed the remains of a gigantic mastodon. The whole of the skeleton was intact, with all the bones extraordinarily preserved and in place, just as the animal had sunk helplessly in the mire several thousand years before. The position of the limbs indicated that the great beast was making a brave struggle and attempt to extricate his weighty body from the pitfall in which he had been mired. Inside of the ribs was found what was the last meal of the mastodon, a mass of from four to six bushels of twigs and branches, one and one-half inches long, leaves, some sort of vegetable substance, half masticated. The skeleton was temporarily stored in the farmer's barn, and shortly afterward the news of the discovery was spread over the country, and attracted the attention of Dr. John C. Warren, a distinguished professor of anatomy in Harvard University at that time, who, recognizing the immense value and importance of the mighty frame as being one of the rare extinct marvels of the past, bought the skeleton. A year afterward he had it mounted, and Sir Charles Lyell and Prof. Louis Agassiz were among some of the first noted scientists to inspect the skeleton by invitation of Dr. Warren. In 1849 it was placed in a little fireproof structure or museum in Boston. Under this exclusive roof it remained practically hidden and buried from the outside world, as only one day or so in the year were visitors allowed access to this private museum. Here it remained until 1906, when for $30,000 this and several other specimens composing the "Warren Collection" were acquired by Mr. Morgan. One of the noteworthy features of unusual scientific interest which Prof. Osborn has brought to light is the size and shape of the animal's brain. By cutting into a section of the skull and opening the brain cavity, it was found possible to obtain a plaster cast of the mastodon's enormous brain. The cast was made by Mr. Otto Falkenbach of the laboratory staff. The giant undoubtedly possessed considerable cunning, keen instinct, and a high order of brute intelligence. The huge 60-foot and 70-foot Dinosaurs like Diplodocus and Brotosaurus, in comparison had incredibly small brains, even less than the size of a tea-cup. The surprising size of the brain which guided this mighty beast is strikingly set forth in comparison with the hen's egg and the one-foot rule, seen in the accompanying photograph. The brain cast is 13½ inches long, 12 inches wide, and 7 inches thick. In life it probably weighed 12 or 15 pounds, and would likely have filled the greater part of a water bucket.



THE HUGE BRAIN OF THE MASTODON.
For comparison of size a 1 foot rule and a hen's egg are also shown.

The mastodon is regarded as a species of fossil elephant, but it differs from the true elephant in the structure of the teeth, which resemble those of a more typical mammal, such as the pig, for instance, and also in having a longer head. A striking view of the elongated lower jaws, showing the number and shape of the teeth mechanism of the mastodon, is clearly brought out in one of the illustrations.

The mastodons flourished in the latter stage of the world's geological history, and their remains in this country are found in the uppermost layers and deposits of the Pleistocene Age. They lived almost in historic times, only a few thousand years ago. The extinction of the race of mastodons, which were of such enormous size and great strength, and able to endure extremes of heat and cold, is thought not to have been due to climatic conditions alone, but to some mysterious and unknown cause. Prof. Osborn suggests that an insect pest may have caused their disappearance from the face of the earth, as such pests to-day are deadly exterminators of mammals in certain parts of Africa. The probable life appearance of the mastodon is realistically portrayed in the accompanying drawing by Mr. Charles R. Knight. The tusks, however, have been determined to have curved inward instead of outward, since the composition was made.



KITCHEN, SHOWING ELECTRIC ELEVATOR BY WHICH THE DISHES ARE CARRIED TO THE DINING ROOM ABOVE.

ELECTRIC DINING TABLE, SHOWING WINE COOLER MAKING ITS ROUND.

AN ELECTRIC DINING TABLE.

A gentleman named Knapp has constructed, and occupies, in Troyes, France, a house which he calls the Villa Feria Electrica, or electric fairy palace, for the reason that servants are almost entirely superseded by electrical machinery. Table service, for example, is accomplished by the following devices:

An electric elevator transports the dishes from the kitchen to the dining room directly above. The dining table is in two parts: a small central table for flowers, fruits, and ornamental pieces and an elliptical annular coun-

ter around which the guests are seated. The interval between the two parts is occupied by a moving band of metal. As each dish arrives from the kitchen it is deposited on a carrier attached to this band. Then the carrier, controlled by keys manipulated by the host, travels around the table, stopping before each guest, turning, if necessary, to present the handle of the soup ladle or the most advantageous point of attack, going back to serve a belated or hesitating guest, making another round, and mutely pleading for the acceptance of a second portion, returning the dish to the elevator, collecting plates and other utensils with some slight assistance by the guests, and proceeding to the service of the next course—all with nearly human and more than butlerian intelligence. The current is furnished by 28-volt accumulators, so that the specter of electrocution is banished from the feast.

Paper Textiles: The New German Material for Yarns and Cloth.

Such extensive interest has been taken in the results of the investigations made at the instance of the Bureau of Manufactures about paper yarn for use in textile industries, that the following particulars, gathered by Consul Carl Bailey Hurst, of Plauen, subsequent to forwarding his report on "Cloth from Paper,"* will prove of further value:

While the term "paper yarn" popularly expresses the new material, the name "wood yarn" is preferable. The yarn proper is cellulose fiber converted into flat strips of the thickness and width required for the making of a particular weight of thread. These narrow strips are spun on especially constructed machines, sometimes alone, or when extra strength is required, round a minute cotton thread, which comprises from two to five per cent, in the strongest yarn, of the material used in xylolin, the variety of paper yarn made in Saxony.

It is not sought to obtain elasticity in the paper yarn; strength and flexibility are the objects in view. Yarn by this new process can be produced from wood fiber far cheaper than from shoddy or the waste of cotton mills; which materials, limited in quantity and irregular in supply, unadapted to the finer shades in dyeing, are more expensive and also inferior to cellulose for the purposes to which xylolin is put. A fabric of good paper yarn may be laundered again and again. An instance may be cited of a piece of white drugget, intentionally placed before a door of a busy office, tramped on incessantly for two years, that has been washed some fifty times, and comes out white and strong, so that its life of usefulness is by no means at an end.

Efforts have been made heretofore to weave common paper twine, but every endeavor has been futile, as it is unsuited for the purpose.

Several patents have been taken out in the United States to turn paper into yarn, and one mill makes its paper yarn under an American improvement, the patent rights to which have long since expired. Paper yarns have been experimented with for over a generation. The German products, from the specimens that have come under my observation, possess perfect uniformity as to thickness and they have no relation whatever to parcel twine.

The question of cost is of first consideration. So far as ascertainable from the Saxon mills, the labor in producing 1 kilogramme (2.2 pounds) of wood yarn is 3 pfennigs (four pfennigs about equal one cent); while in Bohemia it is slightly less. The paper yarn itself is sold wholesale at 80 pfennigs or 19 cents a kilogramme, whereas the cheapest cotton yarn available for the textile industries in the same neighborhood is 2.4 marks or 57 cents a kilogramme—just three times the price. A spinning machine for producing medium numbers of xylolin has from 72 to 100 spindles; 2,000 spindles can produce 6,000 kilogrammes (6 long tons) of the wood yarn in one day. For about 2,000 marks ($476) a machine up to 120 spindles can be built for the spinning of xylolin.

As this yarn can be woven into almost any fabric, such as dress materials, tents, bathing suits, imitation Panama hats, carpets, and grain bags, one manufacturing plant can not well produce all the articles for which paper yarn may be employed. While the industry has well passed the experimental stage, it is nevertheless of such recent development that the paper or wood cloths are not generally found in the retail stores, or at least advertised as such. There are now two mills in Germany producing together 10,000 kilogrammes (10 long tons) of xylolin daily. One large manufacturer, it is stated on credible authority, after obtaining unequivocal results from the new yarn, placed an order for 300,000 kilogrammes (300 long tons) for his carpet mills.

One of the most important jute spinning and weaving firms in Europe has contracted for the privilege of making combination bagging of paper yarn and jute, an article that has proved to be a great success, not only on account of the cheapness compared with bagging of jute, but incidentally having the quality of being odorless; bagging of paper yarn alone can be more advantageously used for sugar, coffee, salt, and other products susceptible to pungent odors. Tapestries, not printed, but woven in colors, as well as toweling of xylolin are alike turned out in great quantities. Not only can the yarn be used in coarser fabrics, but it has also been tried successfully in hand-made cushion laces. There is a desire to take it up in a measure in the machine-made lace center. The yarn can be readily used in knitting and plaiting. Woven xylolin treated with a waterproof dressing does not seem to crack by wrinkling or friction to the injury of the water-resisting coat. One would imagine that a fabric of paper yarn would readily ignite and that a lighted match falling on a paper rug could be exceptionally dangerous. The fact is, however, that a burning match stem will do more damage to a woolen or jute rug and be more likely to lead to disastrous consequences. While not uninflammable, an ordinary rug of paper yarn will burn scarcely easier than a wooden floor. Some criticism, apt to be misguiding, has been offered about paper cloth, with an inclination to compare it to sheet paper or rubber, whereas even underclothing made of paper yarn has been found by experience to be satisfactory. Modern authorities on hygienic clothing decry the wearing o garments that are so woven as to permit only a very slow exchange of the toxic emanations of the body with the outer air. Accordingly, there is everything to hope for in a wide use of woven or knit paper cloth garments, not only among people who can not afford to buy more expensive clothing, but also among well-to-do classes, because the paper material is cleanly and readily laundered; even caustic soap, instead of injuring it, makes the fabric softer.

As stated in a previous report, the purposes to which paper yarn can be put are really so diversified that it is difficult to circumscribe its field of usefulness. It can not be expected that it will appreciably decrease the output of other textiles, but on account of its relative cheapness it has claims that neither manufacturer nor humanitarian can well disregard. Literally it is a new yarn. The commercial success already attained by its discovery demonstrates its practical utilization. Conservative German manufacturers consider it a highly welcome and now well-nigh indispensable material for many textile purposes.

* Published in SUPPLEMENT No. 1626, p. 26206.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

BUCKLE.—J. W. GONCE, Kinderhook, Ala. The invention relates to buckles and more particularly to those applicable to back bands, suspenders and the like. The play of bearing projections in the flange opening allows the engagement or disengagement of a tongue with the locking recesses, and permits the former to adjust itself readily to various thicknesses of straps or webbing which may be used in connection with the buckle.

COMBINED BUST-FORM AND ARM-PAD.—DORA HARRISON, Lansing, Mich. The object of this improvement is the provision of a new and improved combined bust form and arm pad, made essentially of rubber and arranged to permit convenient inflation to any desired degree and without danger of leakage of air and collapsing, to securely hold the article in proper place on the wearer's body, and to insure all the desired comfort to the wearer.

Of Interest to Farmers.

STALK-CUTTER.—R. B. HUMAN, Chickasha, Ind. Ter. This revolving cutter is for use in cutting stalks of any kind upon any character of ground. It is absolutely complete in itself but so constructed that it can be conveniently attached to different wheeled machines, for example, disk cultivators or disk harrows. The cutter may be applied without disturbing operating parts or interfering with their functions, it being also capable of almost instant removal, leaving both it and the machine intact.

Of General Interest.

FOUNTAIN-PEN.—W. K. HOLMES, New York, N. Y. The purpose in this case is to so construct the pen that conveniently-operated means are employed for pressing or collapsing the sack simultaneously approximately its entire length, the pressure being brought to bear parallel with the sack and in a uniform manner. Thus the greatest amount of air is forced from the sack, and when it is permitted to expand a maximum quantity of ink is drawn therein.

SCALE FOR DIVIDING CIRCLES INTO EQUAL PARTS.—O. GAZEL, Havana, Cuba. Mr. Gazel's object is to provide an improved scale for dividing circles into equal parts simply and quickly. With his scale and a proportional divider any circle can be divided in equal parts without computing, drawing, figuring, etc. No time is lost, since there is no trouble in setting the divider points. The proportional divider's long points are set to the standard radius and the other points to the division wanted in the scale. Again open the proportional divider and with the long legs take the given radius of the circle to be divided and at the other point the required space for the division wanted, is found.

BOILER.—C. E. CHAPMAN, Fort Edward, N. Y. One purpose of the inventor is to provide a construction of boiler which will be a rapid producer of steam and one wherein the steam will be heated until when it leaves the boiler it will be in an exceedingly dry state and at a maximum degree of heat. Another, is to construct the boiler with a series of independent coils one above the other, each independently connected with a common water header and a common steam header connected with a steam dome, in the form of a coil, acting as a superheater, being located above the boiler proper.

CLIP-FASTENER.—C. R. SMEAD, St. Paul, Minn. This fastener is for use in connection with files for letters, papers, and the like. An object of the invention is to provide a clip fastener, by means of which the closing flaps of a file may be securely attached one to the other, and which permits the file to be closed or opened by simple manipulation.

LETTER AND NUMERAL RULE.—A. M. WING, Spokane, Wash. The invention pertains to drawing instruments, and its object is to provide an improved letter and numeral rule, which is very simple in construction, easily manipulated and more especially designed for forming numerals and letters of the alphabet, both capital and small letters, without requiring a skilled operator.

PIPE-CLAMP.—G. S. BENEDICT, Kingsland, Texas. The invention is an improvement in pipe-clamps such as are used for withdrawing well casings from wells and other like purposes. Among the objects are the provision of a strong and simple device which is adjustable to take pipes of varying sizes, and which will operate to grip the pipe with increasing force as its resistance to being withdrawn is augmented.

SMOKING-PIPE.—G. W. CLAPP, New York, N. Y. The purpose of the inventor is to provide a construction wherein dual, or a multiple of smoke-conducting channels lead from the mouthpiece to the bowl, and wherein a cleaning finger is used, or multiple thereof, carried by the mouthpiece and adapted to normally temporarily close all the channels, except one through which smoke is drawn, and to so locate and construct finger or fingers, that even when dark one may be shifted to the channel previously in use for the purpose of cleaning and temporarily closing it, at same time opening up a new and clean channel.

LEAD-PENCIL.—C. PINTZ, Budweis, Austria-Hungary. The slider in this invention, and the lead attached to it, may be clamped in position relatively to the holder, so that on the one hand when the pencil is in use the lead is prevented from yielding to the pressure upon its point in writing, and on the other hand the lead when retracted into the holder may be so retained, the design being to obviate the defect which these pencils as at present made are apt to exhibit in consequence of the fit of the slider on the holder becoming impaired by constant use.

HORSESHOE.—A. KWIKKEL, Boyden, Iowa. The invention is an improvement in horse shoes which are provided with detachable calks. The inventor has devised a construction whereby the calks are held securely while in use, but may be easily and quickly detached when required. The shanks are dove-tail shape in cross-section and tapered from end to end, and adapted to slide into the sockets.

SUSPENSORY.—H. A. FRYE, New York, N. Y. The object of the invention is to so support the device that it fits more perfectly and is held more securely in place, permitting the wearer to move about as freely as he may desire without displacing the device or causing any binding or tightening effect. The invention relates more particularly to the supporting means employed.

PICTURE-HANGING DEVICE.—L. RYNEK, New York, N. Y. The improvement refers to a device for hanging pictures and similar articles in a convenient manner, and the principal objects thereof are to provide for adjusting the angle at which the picture is inclined to the wall; to provide for conveniently adjusting the length of the cord or wire by which the picture is hung.

REFRACTORY LINING FOR RETORTS.—F. B. SMITH and G. C. GLYNN, Iola, Kan. The invention is in the nature of a new and improved retort lining and method of applying the same, said lining being intended primarily to be used for protecting retorts or ore muffles used in the distillation of zinc, from the action of corrosive slags at high temperature, thereby prolonging the life of the retorts and saving in zinc.

MOLD FOR SEWERS.—G. GEORGENSON, Wilmington, N. C. The improvement is in expansible molds for use in forming sewers or conduits of various kinds. Adjustment for different forms and sizes may be easily and quickly effected, and the overlapped portions may be quickly adjusted and locked. The mold is also light and easily transported from place to place according to the requirements of work to be done.

GATE.—J. SUTHERLAND, Springer, Ter. New Mexico. The improvements relate to a class of gates which are supported for longitudinal sliding movement by manual effort, and the purpose of the inventor is to provide details of construction for a gate that afford means for opening and closing it with ease. The rotation of a shaft by manual effort through the medium of crank handles or either of them will roll a spur gear along a rack and correspondingly actuate the gate for opening or closing it.

FOLDING CHAIR.—G. H. STRAND, Merrill, Wis. The invention has for its object the provision of a folding chair capable of being adjusted so as to serve as a camp chair, a reclining chair, or a couch. A further object is to provide means adapted to enable the chair to be folded flat so as to be conveniently transported or stored.

Hardware.

HASP.—S. B. PHELPS, Green Hill, Chester Co., Pa. The object of the invention is to produce a hasp which is simple in form and so constructed that it will lie upon the interior; the general purpose being to prevent its being tampered with by a dishonest person. It relates to hasps such as used on chest doors, boxes, or in similar constructions. The fact that the entire hasp is within the interior of the chest and not in position to be reached by an intruder, is not only an advantage from the point of utility, but tends to give the chest a neat appearance.

Heating and Lighting.

DAMPER-REGULATOR.—J. SCALES, New York, N. Y. This regulator is such as is used in connection with boilers or furnaces. The object of the invention is to produce a mechanism for automatically controlling the position of the damper in the flue leading from the fire-box, the object being to reduce the amount of draft when the boiler or furnace becomes too hot or is supplying too great a quantity of steam.

WATER-BACK SHIELD.—S. M. STEVENS, Asheville, N. C. Heat radiated by a hot water boiler connected with a water back attached to a range frequently renders a kitchen uncom-

fortable, especially in summer, and in many cases the backs are removed at such time, and it is often necessary to open the hot water faucet so as to cool the boiler. This device dispenses with such inconvenience and also avoids heating water when not wanted, thereby economizing in fuel.

HYDROCARBON-BURNER.—A. W. Gearhart, Fresno, Cal. The burner is for use in burning low grade distillates. The angle at which the air enters through the front air flue in connection with the air from the top air flue is such that much stronger and steadier flame is produced than by burners of this general class. The draft is sufficient to draw all flame arising in the burning pan and to deflect the same into the fire box, thus eliminating all danger of flames to the user.

FURNACE.—W. J. Hatcher and J. W. Crim, Johnston, S. C. In the present patent the invention is an improvement in furnaces. By this construction of furnace the inventors provide an efficient heating means, requiring but a small amount of fuel and adapted for use in or out of doors. For out of door use it is unnecessary to have a bottom or casing in the furnace.

GAS-REGULATOR FOR BURNERS.—C. F. Gaffney, New York, N. Y. The object in this case is to provide an attachment to a burner, whereby when a vessel or object to be heated is placed over an opening in the stove above the burner a full head of gas will be automatically supplied to the burner, and upon removal of such vessel or object from over the opening the supply to the burner will be automatically reduced to a greater or lesser extent according to the set adjustment of the device, the supply cock being meanwhile open.

ACETYLENE-GAS GENERATOR.—L. H. Hallam, Roswell, Ter. New Mex. The invention pertains to a mechanism for automatically generating acetylene gas. In this apparatus the water supply means are entirely automatic and absolutely reliable, their action not depending upon valves and other complicated devices. The filter lies above the carbid bed and precipitates into the same any solid matter rising from the gas. The filter is not liable to saturation and keeps always in proper condition.

VAPOR-BURNER.—A. H. Waite, El Paso, Ill. This invention pertains to burners using gasolene or like liquids as fuel, and its object is to provide a burner arranged to quickly start the generation of the vapor without creating undesirable smoke, and to prevent the formation and escape of gas into the room after the burner is turned out, thus rendering the latter smokeless and odorless.

Household Utilities.

INSECT-TRAP.—B. J. Mattingly, Beeville, Texas. Vermin of the insect type seek refuge in the slot, the sockets and the bores of the trap. To destroy the vermin, the trap is seized by the handle and the body thereof thrust into hot water, and then the dead are shaken or knocked out of the hiding places. The form of trap enables it to lie or retain its place upon a bed slat or spring or other part.

WINDOW-SCREEN.—J. Stork, San Diego, Cal. In this instance the invention relates to improvements in screens for windows of the casement type, that is, in which the sash is hinged to the casing so as to swing, the object being to provide a simple means of mechanism whereby the screen may be easily raised and lowered and wholly independent of the sash.

FOLDING BED.—Anna C. Thew, New York, N. Y. The invention refers to improvements in folding beds, and more particularly to means whereby the bed may be concealed and supported in the minimum amount of space when not in use, and capable of being separated from its inclosing casing and moved to any point when about to be used. The inclosing casing resembles a bookcase, and the upper portion of the casing is adapted for storing bedding and the like.

BROOM-HANGER.—Bertha Clark, New York, N. Y. The main object of the invention is to provide suitable means adapted to be attached to the handle of a broom, sweeper, mop, or the like, to enable such article to be hung on a wall or bracket. When the broom is in use means are provided to make the top and sides of the handle smooth and free from any projection that would interfere with the comfort of the user.

BED.—W. H. Cling, Charleston, S. C. In carrying out the invention, Mr. Cling adapts the improvements for application to an ordinary metal bed. It is an improvement in beds especially designed for use of invalids. The mattress cover of the middle section has a suitable cut out portion in register with a seat and a pad to close the same when the commode is not in use and the bottom sheet of the bed may have a flap cut away on three sides to register with the pad.

KITCHEN-CABINET.—H. Harrild, Spokane, Wash. The invention is an improvement in kitchen cabinets, being in the nature of a combination kitchen table, kitchen safe or cabinet and dining table. A stand is provided below the top board with pans which may be used for meal, flour, and the like, and between the same with a drawer for knives and other cutlery and below the drawer with a bread board, which may slide in and out.

DOUGHNUT-CUTTER.—A. E. Baum, A. Schoel, and C. E. Edwards, Waterloo, Iowa. In carrying out the invention special means have been provided for readily shifting the machine from the bowl or other receptacle containing the dough to the kettle containing the hot grease in which the doughnuts are cooked. The cutter positively feeds dough or the like of varying consistencies and forms it rapidly into uniform rings known as doughnuts.

Machines and Mechanical Devices.

SAWING-MACHINE.—T. R. King, Hope, Ark. The pattern and work in position in the support and the saw started, the support is moved from left to right, a strip being removed from the work by the saw during the movement. The support returns to original position, and the pattern is partially rotated to bring another surface in contact with rollers of the rocking frame. Work moves in accordance with the pattern, and when the support is again moved from left to right, another strip is removed from the work. The less the amount of rotation of pattern between each successive movement, the more nearly will the finished work correspond to the pattern.

SAWING-MACHINE.—C. A. Kallstrom, Luffenholtz, Cal. The principal object in this case is to provide an apparatus which may be conveniently adjusted and guard an operator from accident. As the carriage moves vertically there is substantially no friction on the track and no lost motion; and as the cutting takes place at the sides of the saw, the dust will leave it in a vertical direction, rendering it easier to dispose of. With this improvement it is possible to use thinner saws, thus saving lumber, and the saws may be used longer.

STICK-FEEDER.—I. E. Bedell, York, Pa. This improvement refers to drying machines for wall paper and the like, and its object is to provide a stick feeder, arranged to feed flat sticks singly and accurately spaced apart onto an endless carrier, without danger of the sticks being wedged or clogged in the machine or broken or irregularly placed in position on the carrier.

AUTOMATIC GROOVE-CUTTING MACHINE FOR WOODEN SHOE-SOLES.—H. Busse, 96 Augsburgerstrasse, Berlin, Germany, and W. Schou, 3 Peder Skramsgade, Copenhagen, Denmark. This invention relates to a cutting-machine, by means of which it is possible, through a simple but automatic device, to effect a regular cutting of the grooves in such objects as the soles of wooden shoes, in which are secured the leather uppers. It has for its principal objects the provision of mechanism whereby the sole as it is rotated is varied in its angular position so that the cutter will follow the curve of the sole.

AUTOMATIC PUMP-COUPLING.—C. B. Haldeman, Aurora, Kan. This coupling is especially adapted for use with wind mills. When the lever is in position against the pump handle the motion of pumping will automatically couple the piston rod and the pump handle, and when the handle is released, the mill will be automatically coupled with the piston rod. The angular portion of the upright bar is provided at the end adjacent to a brace with lugs, against which a friction roller of the frame is adapted to rest when the handle is released from the pump.

SAWMILL-GAGE.—A. M. Dow, Burkettville, Maine. The invention relates to improvements in gages for lumber saw machines, the object being to provide a gage of simple construction that may be quickly adjusted for different thicknesses of boards to be cut from logs. The sawyer standing in front of the machine may readily change the position of the block and therefore change the distance of the gage roller with relation to the log of the sawmill carriage.

MINING-COLUMN.—J. W. Kittredge, Boulder, Col. This column is intended for use in mining operations and elsewhere, where great pressures are required. In mining it is adapted to be held in place by extending the column so that it presses tightly against the floor and roof, or against opposite side walls, of the tunnel or drift in which the column is being used, and which is adapted to support pneumatic drills or heavy tools used in mining purposes.

VARIABLE-SPEED MECHANISM.—W. Bowne, Jr., and M. Cronkhite, New York, N. Y. In the present patent the invention has reference to means for varying the speed of a driving shaft, and the improvement is especially designed to be used in connection with motor vehicles, although adapted for various uses. When the device is in operation, the driving shaft is rotated by the motive power operating the device, and the gear on the driving shaft rotates the gear mounted upon the stud.

DITCHING-MACHINE.—J. S. Blackie, Carson City, Nev. The aim of this inventor is to provide a ditcher that will rapidly handle the dirt, gravel, and other matter in the excavating of ditches, and to so construct the machine that the width of the trench may be gradually diminished as the depth increases, thus providing side walls or banks at any desired angle which will aid materially in preventing washing out or caving.

TRANSMISSION MECHANISM.—G. H. Wood, Glen Cove, N. Y. This mechanism is especially useful in driving machinery at different speeds. The invention is especially applicable in the driving mechanism of vehicles, motor boats, and under similar conditions where the machinery must have a wide range of speeds. The mechanism can be quickly controlled so as to change the speed as desired.

Prime Movers and Their Accessories.

FRICTION-CLUTCH.—J. W. Leonard and H. E. Brown, Washington, Pa. In this instance the invention has reference to friction clutches designed to be used on convertible gas and steam engines, and has for its object the provision of a device simple in construction, effective in operation, and durable in use. The clutch may be adjusted to be used with a gas or steam engine, by simply adjusting the outer nuts in contact with or away from the fixed collar of the threaded bolt.

Railways and Their Accessories.

AUTOMATIC CONTROLLER.—A. E. Osborn, New York, N. Y. The principal object here is to provide for automatically closing the throttle valve of a locomotive should the engineer disregard a signal to stop or slow down his train to which end Mr. Osborn provides a fluid pressure motor in connection with the throttle and with means for automatically affecting the operating pressure so as to operate the motor at the proper time. Provision is made for venting the train line of the automatic brake system thus applying brakes as well as throttling the engine.

TRAIN-STOPPING DEVICE.—G. J. Gumm, Chetek, Wis. The invention is in the nature of an apparatus for stopping trains automatically in case of a misplaced switch, open drawbridge, etc., and it consists in the construction and arrangement of the switch operating mechanism in connection with track devices set at a distance away from the switch, and co-operating devices carried by the train, so that if the switch be open the air brakes on the train are set, and the throttle valve closed in an automatic manner, thereby bringing the train to a stop before the open switch is reached.

CAR-FENDER.—G. M. Andersson, Hyde Park, Mass. The object in this instance is to provide a fender with means adapted to compensate for vertical vibration of a car body on its truck, and thereby maintain the forward portion of the fender at a constant elevation from the track, to provide for adjusting the fender bodily at the desired elevation, to enable the forward end of the fender to be dropped automatically by an object in its path, and to pass under an object and raise it on to the fender instead of striking it, and to operate promptly without attention or assistance of the motorman.

SUPERHEATER.—S. Munson, Fowler, Col. The superheater is designed to be used in connection with tubular locomotive boilers, and the object of the inventor is to provide a superheater having an ample heating surface and adapted to permit of the passage of a large volume of steam, and to be firmly secured in the smoke box of a boiler with its center of gravity so placed as to exert the least strain on the boiler, and so arranged as to provide ample accommodation for the exhaust and connecting mechanism and to permit free access to the ends of the boiler tubes.

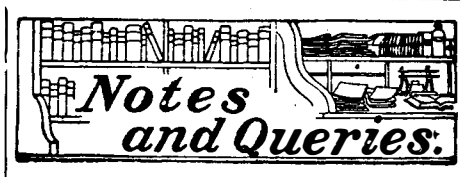
LOCOMOTIVE.—J. W. Finch, Elizabeth, Miss. In operation when high speed is desired, a block is moved in the slot to bring the gear wheel into contact with the pinion, while when low speed with greater power is needed, the block is moved to bring the same in mesh with the internal rack. Since the gear wheel is rigid with the connecting rod, it must rotate the drive wheel in same direction with revolution of the connecting rod. When the gear wheel is placed in position intermediate the rack and pinion, the driving mechanism is out of engagement with the drive wheel, which may rotate freely without wear upon cylinder and valve mechanism.

Pertaining to Vehicles.

VEHICLE-WHEEL.—O. Skog, New York, N. Y. In the present patent the invention is designed to provide a vehicle wheel with means simple in construction, effective in operation, and durable in use, adapted to overcome the shocks and jars caused in traveling over a rough or uneven roadbed without the use of pneumatic tires.

HYDRAULIC CONTROLLER FOR VEHICLES.—J. W. Anderson, Weed, Cal. This invention relates to a new and improved means for controlling motor vehicles, and comprises a hydraulic cylinder operated by water or other liquid under pressure, and preferably by a portion of the water normally used for circulating around the gas engine or condensing the steam on an automobile if a gas engine or a steam engine be employed.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

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Minerals sent for examination should be distinctly marked or labeled.

(10601) H. F. B. asks: 1. We have learned from reference books that the stereoscope is an optical instrument, by means of which two pictures, each taken from slightly different points of view, are magnified, and so combined into one that, in the resulting picture objects have the appearance of solidity and relative distances are easily conceived. This effect, which the cyclopædia calls an illusion, gives to a picture, or rather the things in it, an appearance as observed in nature. Now a friend of ours claims that nature has given us two eyes with the very same purpose in view, i. e., to observe solidity of objects and relative distances. He says that when one becomes blind in one eye, the imagination makes up for the deficiency; that to a person, fairly educated, and blind in both eyes to a certain age, when sight is suddenly restored to one eye, all objects in the background and foreground would blend, and form a flat picture, as observed in a photograph. We claim that nature gives us two eyes for the same reason that she gives us two ears, nostrils, and lungs, that we become accustomed from childhood to notice solidity and relative distance; that the man who suddenly sees from one eye, would in time have no more difficulty in noticing these properties of nature, than a man suddenly seeing from both eyes. Who is correct? A. We have never been blind in one or in both eyes and had sight restored, so can say nothing from experience regarding the vision of solidity of objects by persons who have had this experience. We, however, do know that persons, one of whose eyes is covered by bandages, cannot tell the distances of objects with any accuracy. We have many times seen the experiment tried upon people, and always with the same result. We are told by people with one eye that they do not gain the ability to tell unknown distances with any degree of certainty. We are very certain that we have two eyes for the purpose of determining distance and the solidity of objects. 2. What causes the phenomenon noticed over a field on a hot day, or a stove—radiant heat or convection currents? I say the latter. A. We presume by your second question you refer to the apparent trembling of objects when seen over a stove or over a hot radiator. The phenomenon is due to the unequal heating of the air, so that the light is unequally refracted as it passes through the layers of air of different densities. The convection currents set up in the air are the cause of the waving motion of the objects seen through the heated air. 3. We read somewhere that a perfect clock would be about fifteen minutes fast at one time of the year, and fifteen minutes slow at another; but again and again we hear of clocks and watches which require no regulation for months at a time. Please explain the inconsistency. A. A mean-time clock will be ahead of and behind the sun as you state. No clock can be made which can keep apparent solar time, since the days by the sun are not of the same length throughout the year. The word *day* here does not mean the time from sunrise to sunset, but the time from apparent noon to apparent noon again. See Moulton's "Astronomy" for this and the Equation of Time. We send the book for $1.60. All common clocks keep mean time, and not solar time. There is no inconsistency. 4. We know that a feather and piece of lead weighing the same have an unequal fall in atmosphere, and an equal fall in vacuum; but some claim that all bodies, without respect to weight, have an equal fall in vacuum, which seems preposterous to us. What is the truth? A. All bodies fall with the same velocity at the same place in a vacuum. It is not preposterous. If a feather and a piece of lead will fall with the same velocity in a vacuum, then all things will do so.

(10602) Lieut. J. C. says: You would be very kind informing me the quickest possible of the value of the resistance of the insulation of the armature of a dynamo compound of 80 volts, 400 amperes, direct current, to be considered in good order. A. If the insulation resistance of this machine from frame to winding is one megohm, it is very likely in good condition. Be sure that all carbon dust, oil, and dirt are removed from the brush rigging before testing in order to give the machine a fair chance.

NEW BOOKS, ETC.

THE TWENTIETH CENTURY TOOLSMITH AND STEELWORKER. By H. Holford. Chicago: Frederick J. Drake & Co. Fully illustrated; 12mo.; cloth; 240 pages. Price, $1.50.

A very complete set of directions for working steel. It contains methods of both a general and of a special nature, including specific accounts of the making of a number of tools. The author is a man of the greatest practical experience, and his book contains the results of the intelligent observations that he has made during a lifetime successfully spent in the carrying on of his craft.

THE MECHANICS OF HOISTING MACHINERY. Including Accumulators, Excavators, and Pile Drivers. By Dr. Julius Weisbach and Prof. Gustav Herrmann. Authorized translation from the second German edition by Karl P. Dahlstrom. New York: Macmillan Company. 8vo.; cloth; 332 pages; 177 illustrations. Price, $3.

This work is translated from Prof. Herrmann's edition of Weisbach's great work on "Engineering Mechanics." Several volumes of this treatise are already familiar to English readers through the translations completed successively by Messrs. Coxe, Du Bois, and Klein, treating respectively of Theoretical Mechanics, Steam Engines and Hydraulics, and Machinery of Transmission. The present section, however, has never heretofore appeared in English print, although its great value has been recognized by all the above able translators, and by institutions of learning all over the world. The need of such a textbook as this is great, and this translation will fill a great want. In itself the treatise is particularly comprehensive and complete. It treats of all the important forms of hoisting machinery, from the ordinary lever and jack to the most complicated form of crane. The text contains many problems, all of which are dealt with in a manner sufficiently simple to be readily followed by any one having the ordinary knowledge of mathematics.

UP-TO-DATE AIR BRAKE CATECHISM. By Robert H. Blackall. Twenty-first edition, revised and enlarged. New York: The Norman W. Henley Publishing Company. 12mo.; cloth; 374 pages; fully illustrated. Price, $2.

The altered conditions of railroad service which now prevail, consisting in the use of longer trains, of cars of greater capacity, and of locomotives with power and weight commensurate with their increased duties, have made imperative radical changes in the air-brake art. The original air-brake was designed to handle a train of a maximum length of fifty cars, each having a capacity of sixty thousand pounds. At present trains are usually made up of 100 cars, each having a capacity of one hundred thousand pounds. As is quite natural, the locomotives have also been increased in hauling power in order to stand up to their added requirements. The new information necessary to handle this up-to-date equipment has been incorporated with the former editions of the "Air Brake Catechism" to make this, the twenty-first edition. Written in familiar class-room style, it embodies in the form of "question and answer" a complete discussion of all parts of the air-brake equipment, the troubles and peculiarities encountered and a practical way to find and remedy them.

LESSONS ON SANITATION. A Hand Book for Students Arranged on the Principle of Question and Answer. Forming a Complete Course of Study on the Subject. By John W. Harris. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Company. 12mo.; cloth, 175 pages; 53 illustrations. Price, $2.

"Lessons on Sanitation" consists of four hundred questions and answers arranged in fifteen lessons. The first fourteen lessons are made up of twenty-four questions and answers each, and the fifteenth lesson of sixty-four questions and answers. The lessons are illustrated by fifty-three illustrations, and preceded by a list of abbreviations used both for examination and in practice. As a conclusion, there is given, in an appendix, a list of the places and societies holding examinations in sanitation, with the names and addresses of the secretaries. Although this work is written from the English standpoint, and although the questions are based upon the English Sanitary Acts, its usefulness is only to a certain extent impaired by this slight difference from our point of view. Even in America much benefit can be derived from this book, although an American would not be able to get the useful information with regard to the actual condition of the law that an Englishman would get in regard to his laws from the same volume.

ELECTRICAL WIRING AND CONSTRUCTION TABLES. By Henry C. Horstmann and Victor H. Tousley. Chicago: Frederick J. Drake & Co. 16mo.; leather; 119 pages. Price, $1.50.

This book is primarily intended for "pocket reference." For that reason, much of the matter that is usually included in so-called hand books, such as tables of tangents, logarithms, and matters that come into use only on very extensive or elaborate installations, has been omitted. Engineers or contractors are not usually called upon to give estimates or information on such work at a moment's notice, consequently there is little need of carrying about a volume containing such data. The need is rather for a really practical handbook which will give in as complete and concise a manner as possible that information which the wireman, the foreman, the contractor, the engineer, or the architect is in daily need of, and which, without the aid of such a work, requires tedious calculation. This volume will meet all these requirements, and will be found convenient and efficient both in its contents and in their arrangement.

CASSELL'S ENGINEER'S HANDBOOK. Comprising Facts and Formulæ, Principles and Practice, in all Branches of Engineering. By Prof. Henry Adams. Philadelphia: David McKay. 8vo.; cloth; 576 pages. Price, $2.50.

A compendium of hints useful in refreshing the memories of practical civil engineers. The measurements are in the English system, a fact that will appeal strongly to many.

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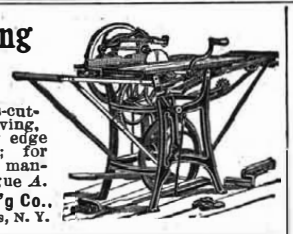

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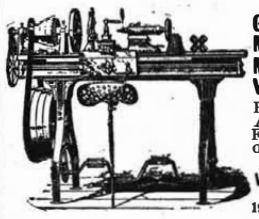

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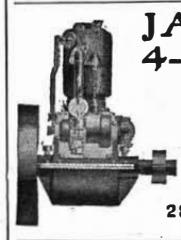

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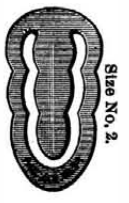

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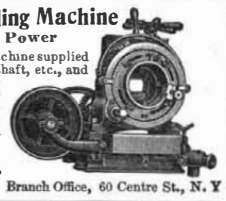

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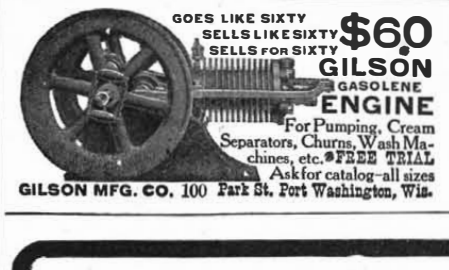

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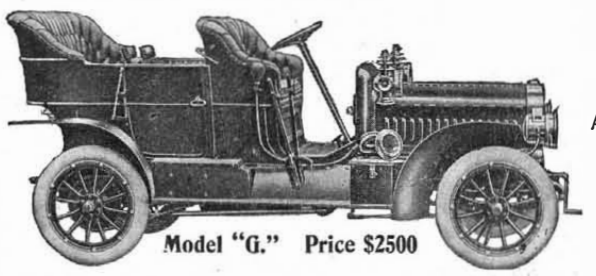

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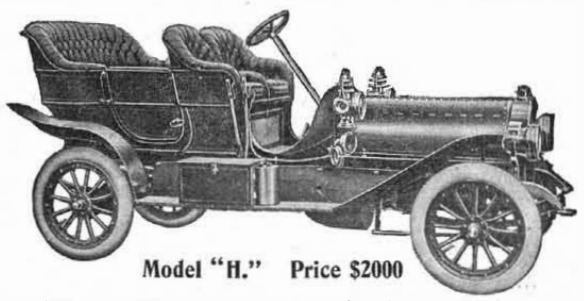

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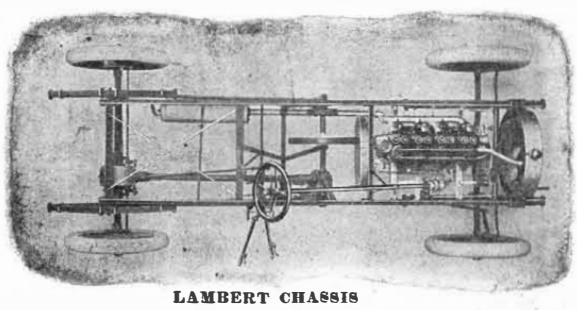

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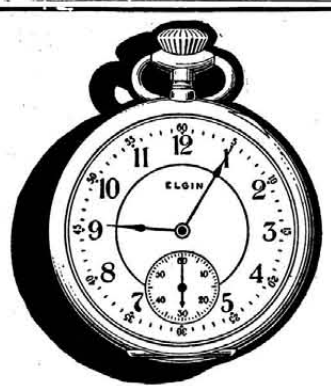

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Tablets, cathartic, Keystone Medical Co.	64,288
Tea, Grace Brothers & Co.	64,259
Tea, A. Ethridge & Co.	64,283
Tea, German-American Coffee Co.	64,284
Tea, Mazawattee Tea Co.	64,289
Textiles, certain, Hagadine-McKittrick Dry Goods Co.	64,309
Thread, spool cotton, and sewing silk, American Thread Co. 64,186, 64,209 to	64,214
Threshing and grain-separating machines, Avery Manufacturing Co.	64,159
Tires, elastic vehicle, Goodyear Tire and Rubber Co.	64,242
Tobacco, twist, Axton Fisher Tobacco Co.	64,271
Tonic beverage, celery, Schoneberger & Noble	64,229
Tonic, chill, Dowell, Wood & Cooper.	64,278
Tools, certain hand, A. W. Wills & Son.	64,181
Veilings, net, S. Oppenheimer & Levy	64,224
Waffle irons, A. M. Anderson	64,295
Washing powder, J. F. Shipley	64,315
Water, carbonated drinking, Wm. B. Riker & Son Co.	64,206
Water, mineral, H. R. Melster	64,197
Waters, mineral and aerated, Cantrell & Cochrane	64,191
Whisky, Morten & Co.	64,198
Whisky, E. Martin & Co.	64,218
Whisky, Frankfort Distillery	64,241
Wines, port and sherry, Geo. G. Sandeman Sons & Co.	64,221
Woolen, silk, and velvet piece goods, M. Rosenbaum's Sons	64,203
Wrenches, Frank Mossberg Co.	64,165
Yarn, cotton, Howard Manufacturing Co.	64,243

LABELS.

"Alice Rose," for canned corn, Fernald, Keene and True Co.	13,699
"Asthma Oil Black," for a medicinal preparation, L. E. Moore	13,703
"Asthma Oil Drops," for a medicinal preparation, L. E. Moore	13,704
"Bedford English Silver Polish," for a silver polish, E. Schaefer	13,711
"Bishop's Original Cracker-Nut-Candy," for a confection, F. P. Bishop	13,700
"Burk's Boiled Ham," for smoked and cured meats, L. Burk	13,694
"Burk's Lunch Roll," for smoked and cured meats, L. Burk	13,695
"Canoe Girl," for candy, National Candy Co.	13,702
"Carnival," for canned corn, Fernald, Keene & True Co.	13,698
"Cuttle's Anti-Shrink Compound for Woolens," for a compound for woolens, Home Laboratories	13,712
"Dr. Gottleib Hermes' Universal Pills," for pills, F. J. Hermes	13,707
"Elk Brand," for meats, Northwestern Provision Co.	13,696
"Feist Natural Gas Mantle," for incandescent gas mantles, Feist Gas Mantle Manufacturing Co.	13,710
"Ginsing," for beverages, Ginseng Products Co.	13,708
"Lorcer, good for all belts leather and rubber," for a dressing to stop the slipping of belts, A. Sommer	13,713
"Oriental Ointment," for a medicinal ointment, H. A. Ingmand	13,705
"Poland," for canned corn, Fernald, Keene & True Co.	13,697
"Sigari Toscani," for cigars, P. Capobianco	13,709
"The Debutante," for candy, National Candy Co.	13,701
"Tiger Fat Salve," for salves, W. A. Gray.	13,706

PRINTS.

"Eve, The Texas Mi-Cro-Line Girl," for proprietary medicines, Mi-cro-line-Medicine Co.	2,067
"Fashionable Coat Sleeves Fall and Winter 1907-08," for coat sleeves, Ed. V. Price & Co.	2,068
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"Parisian Chocolate Co.," for chocolate, F. A. Rhodes	2,066
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A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

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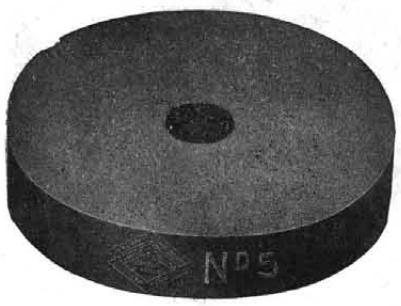

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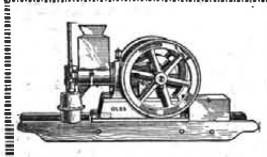

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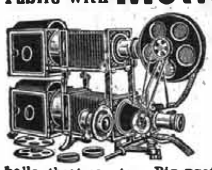

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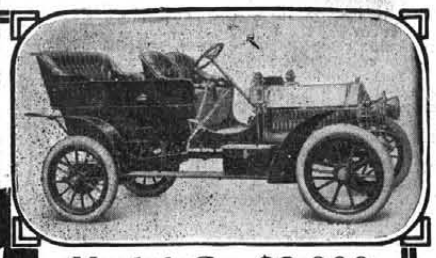

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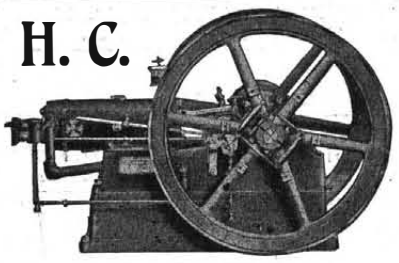

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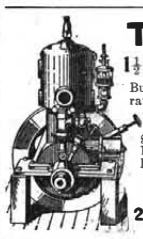

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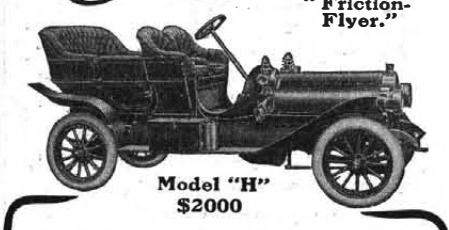

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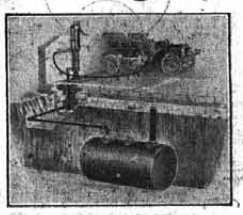

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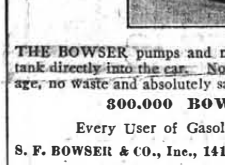

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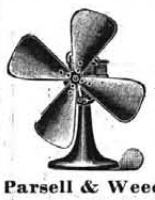

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